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OF THE

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EXTERNAL ASPECTS OF ORGANIC NATURE

PRODUCED BY

MAN'S INTERFERENCE.

BY

PROFESSOR GEORGE ROLLESTON, F.R.S.,

OXFORD.

[A LECTURE DELIVERED AT THE EVENING MEETING OF THE ROYAL GEOGRAPHICAL SOCIETY, MAY 12TH, 1879.]

LONDON:

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THE modifications of the external aspects of organic nature produced by man's interference form so large a part of the results of all human activities whatever, that the very first thing to be said in a single evening's lecture on the subject should consist in a specification of the particular spots in that vast area which the speaker proposes to touch upon. I propose, then, with your permission, firstly, to glance at certain of the alterations, positive and negative, in the landscape of our own country, which we ourselves and our fathers before us have intentionally or unintentionally produced; secondly, to notice a few of the many alterations produced by disforesting in our own and other countries; and thirdly, to show what our knowledge as to the localities to which the parent stocks of the majority of our domestic animals and of our cultivated plants may be assigned, implies, as to the modifications of other regions of the world's surface which man has produced by his processes of importation and acclimatization. A few speculations as to the future may perhaps be found room for after these details as to the past and present.

I do not propose to enter into the large question of the extent to which man may, with any propriety, be spoken of, as he has been, as a "geological agency," a "telluric" or a "cosmic" agent; and I will at this very outset of my lecture profess that I think man's power of modifying the climate of the earth upon

which he lives must be considered,* when all the facts of the case are taken into account, to be confined within much narrower bounds than some writers are willing to admit. It is possible to overstate the extent to which man can go in the direction of exhausting the soil by wasteful or neglectful agriculture, and to fall over-easily, not to say over-willingly, into despair as to the restoration to fertility and political consideration of countries so mismanaged. And if it is possible to overstate man's influence upon the dry land and its inhabitants, it is necessary to be very cautious as to asserting for him any power of altering, except infinitesimally, the vast area of marine life. Now, as the surface of the sea is to that of the land as four to one, and as I feel somewhat desirous of showing that the extent of the subject I have chosen is not quite so disproportionately large in relation to your time and my abilities as the mere words in which it is announced might seem to indicate, I should like to dwell a little upon this delimitation of it before entering upon the subject itself.

For one of those striking suggestions *qui font penser si elles ne font pas croire*, has been made to the effect that man's inter-

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* Upon this large question, one only of many large questions which the various details of this subject suggest, and by which, even when most in the concrete, they excite general interest, it is well to hear Mr. Robert Rawlinson as he spoke in a lecture on Meteorology, delivered November 1868, before the Royal Engineers at Chatham (p. 7) :—

"It is certainly true that man modifies climate over tracts that have been cultivated; but it is asserted, further, that in various parts of the world, through cutting down forests, and in consequence of other operations, the works of man, climate has been so far modified as to have had its character absolutely changed. 'The Thames is not now frozen over as in times past,' one place has more rain than formerly, another place less, and so on. If by assertions such as these it is intended to be implied that any works of human hands have actually altered the current course of nature, I must meet such allegation with a positive denial. The most stupendous of human works can affect only the comparatively small and narrow space of the earth's surface upon which they may have been executed. Evaporation has only an indirect and incidental reference to the land—its real dependence being on the great ocean and the greater sun. And so, while man may exert an influence upon climate over the little area of his operations, his works can avail nothing to affect the grand features of nature even over that small area, or to disturb the majestic scale on which she accomplishes her purposes. Cosmical meteorology is unaffected, and must continue to be unaffected by human agency. The powers of man can never seriously modify the heat of the sun, cloud, rain, or climate, as these have reference to the world at large; all statements, therefore, which would assign cosmical atmospheric effect to the cutting down of forests, to land drainage, land cultivation and such like agencies, must be treated with practical disregard."

For other discussions on the same subject, see Reclus, 'The Ocean,' sect. ii. pp. 93–95, *ibique citata:* Unger, as regards Egypt, 'Sitzungsbericht Akad. Wiss. Wien,' xxxviii. pp. 89–93, 1859; De Candolle, 'Hist. des Sciences,' 1873, p. 412; Link, 'Urwelt und Alterthum," ii. pp. 128–160, 1822.

ference has been potent, even over the sea, to an extent which men of science have not usually claimed, and poets have denied to be possible. Mr. G. P. Marsh, the author of a well-known work on 'The Origin and History of the English Language,' 1862, as well as of the highly interesting work on physical geography which appeared in 1864, under the title of 'Man and Nature, or Physical Geography as modified by Human Action,' and as a second edition, ten years later, under the title of 'The Earth as modified by Human Action: a new edition of Man and Nature,' suggests in this latter work that the phosphorescence of the Mediterranean, unknown to, or at any rate scarcely noticed by, the ancient writers, may have been greatly increased since their days through human action in the way of extirpating the whale. "Is it not possible," writes Mr. Marsh,* "that in modern times the animalcula which produce it (the phosphorescence of the Mediterranean, the most beautiful and striking of maritime wonders), may have immensely multiplied, from the destruction of their natural enemies by man, and hence that the gleam shot forth by their decomposition or by their living processes, is both more frequent and more brilliant than in the days of classical antiquity." In a more utilitarian spirit Middendorff, in his 'Sibirische Reise,'† points out that a continuance of the wasteful destruction of the whalebone whale in the northern seas will render it impossible to utilise for man's profit the innumerable small crustacea and mollusca of the Polar seas which that whale converts into train oil! The profligate inconsiderate slaughter again by the Kolushes of the sea-cow, *Rytina Stelleri*, a sirenian "whale" of the region of Behring's Straits, which lived upon sea-weed, has reduced these savages to the necessity of using this self-same sea-weed for manuring their potatoes, which useful vegetable, however, gives them a much less savoury and sustaining food than was manufactured, so to say, for their forefathers in the organism of the sea-cow they extirpated. It is perhaps a little ungracious to point out that the most elegant of these three correlations and interdependences is not so definitely demonstrable as the other two. In the first place, it may be objected as regards Mr. Marsh's suggestion, that the Mediterranean whales,‡ not comprehending in

* *Loc. cit.*, 1st ed. p. 114; 2nd ed. p. 104.

† Band iv. 2 t. p. 848, 1867.

‡ The principal larger cetacea of the Mediterranean are piscivorous dolphins, such as *Delphinus tursio*, *Delphinus globiceps*, *Delphinus orca*; it is at least open to doubt whether such whales as the Balænopteræ and the sperm whale can be considered as anything more than occasional visitants of Mediterranean waters. See

their number the right whale, *Balæna mysticetus*, are not whales which would either themselves prey so largely or exclusively upon the small invertebrata alluded to by Middendorff, to say nothing of those very much smaller, upon which the phenomenon of phosphorescence so much more largely depends; or be themselves so unrelentingly pursued by man for the sake of their oil. And secondly, without dwelling upon any such quantitative relations as the size of the microscopic "animalcula" just alluded to may suggest, it is clear that the square area of the Mediterranean makes up a space for the extirpation from which even of so large an animal as a "whale," a very considerable fleet would have been required. We know the numbers and the tonnage of the ships which, till the discovery of petroleum * in large and available quantities, formed the whaling fleets of quite recent times, 1849–1850, the American whalers in the Sea of Okhotsk alone numbering 250† three-masted vessels, with a minimum tonnage of 500 tons; but of any such whale-slaying machine having ever existed in the Mediterranean we have, within my knowledge, no record whatever. Now the capacity of the ancient writers for "not marking withal" matters of interest to the modern naturalist, can scarcely be overrated; but it did not affect matters relating to war and the chase so much as such trifles as Stonehenge and the peaceful though colossal aqueduct near Nîmes.‡ And as a matter of fact, we find in those writers abundance of references made to the means employed for the capture of the tunny, a form of the chase which is in no way more exciting, more useful for illustration and metaphor, nor even more lucrative, than would that of the whale have been if it had been carried on to any appreciable extent in the large sea on the shores of which so much of the history of the world has been written and acted. The Greek word *κητεία* means a fishery, not of Cetacea, but of tunnies.

A story relating to the natural history of these true "fishes" will show, in the way of a parallelism, the facility with which mistaken views may obtain currency, *si modo imaginationem feriant aut intellectum vulgarium notionum nodis astringant*, quantitative measurements, statistics, relative proportions of

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Wagner, "Die Geographisehe Verbreitung der Säugethiere," 'Abhandl. d. 2te Classe d. Ak. d. Wiss. Münehen,' iv. Bd., Abth. i.; and Sundevall, 'Die Thierarten des Aristoteles,' 1863, p. 88; 'Aristoteles' Thierkunde,' Aubert und Wimmer, Bd. i. pp. 73–74, 1868.

* See Marsh, 'The Earth as modified by Man's Aetion,' 1874, p. 103.

† See Middendorff, *l. c.*, p. 849. ‡ Marsh, *l. c.*, pp. 426–427.

masses to other things, and even literature itself, notwithstanding. In the Oxford University Museum we have a large skeleton of a tunny (*Scomber thynnus*), brought from Madeira, before my time, by my friend, Dr. Acland. A foreign naturalist, whose name, under the circumstances, I think well to withhold, but whose reputation is commensurate with his very extensive performance, going over the Museum with me one day, remarked, after paying a not undeserved compliment to the skeleton, "That fish never came from the Mediterranean." I answered that, as a matter of fact, it had belonged to an ocean-going individual; but I also asked how it was possible to differentiate a Madeiran from a Mediterranean specimen. My friend answered, "The Mediterranean is too closely fished by man to allow of any tunny attaining such dimensions." I was silent, though very vivid recollections of long, however pleasant, days of coasting on those shores, without meeting any considerable number of vessels, or passing, as on the south coast of Asia Minor, any considerable towns except in ruins, might have conspired with my recollections of St. Paul being driven up and down for fourteen nights in Adria, to make me question this explanation. Some time after, I found that Cetti records tunnies of no less than from 1000 to 1800 lb. as being caught now-a-days in the Sardinian fisheries! *

The results of investigation into the extent to which man's interference may have told injuriously upon the propagation of fish smaller in size, if not smaller in importance, such as the herring, may possibly show us that here too we have exaggerated our own powers for mischief. Not only is the sea a large field, but cyclical oscillations in the "Frequenz" of its inhabitants are at least as possible, irrespectively of our interference, as are the similar variations observable in air-breathing animals; and many an animal, as, for example, the horse in South America, has become extinct even in recent, not to speak of earlier geological times, owing to quite other than human agencies. Man has no monopoly of destructive agencies, neither, if he had, would that, as it seems to me, prove that, "though † living in physical nature he is not of her, that he is of more exalted parentage, and belongs to a higher order of existences." He is not, in strictness of language, a "cosmic," a "telluric," a "geological," nor a "supernatural agency." He may ultimately obtain, as prophesied by Mr. Wallace,‡ such a

* See Lenz, 'Zoologie der alten Griechen und Römer,' 1856, p. 485.
† Marsh, *l. c.*, p. 34.
‡ 'Natural Selection,' p. 326.

mastery of the dry land as to supersede on that portion of the world's surface the agency of natural selection; but he cannot even there effect cosmical changes in the climate, and as regards the sea, it is possible enough, as Mr. Moseley has suggested on the two concluding pages of his 'Notes by a Naturalist on the *Challenger*,' that when the present races of animals, plants, and men shall have perished, the deep-sea animals, at least, if not those of higher levels, "will very possibly remain unchanged from their present condition."*

* Having been compelled to express dissent from Mr. Marsh's suggestion as to the phosphorescence of the Mediterranean having been a less striking phenomenon in ancient than it is in modern times, I cannot forbear to pay my poor meed of thanks to this writer for the pleasure and instruction which his works have afforded me. The 'Kulturpflanzen und Hausthiere,' of Herr Victor Hehn resembles Mr. Marsh's work in dealing with the subject of man's action on organic nature in a way which attracts the attention and stimulates the thought at once of the politician, of the literary man, and of the man of science. I expressed my opinion upon the merits of the first edition of this work in the 'Academy' of August 15, 1872. A third edition of it appeared in 1877, considerably enlarged and improved. And it may be observed that for dealing at all adequately with this subject, and indeed for avoiding very gross blundering in so dealing with it, a man must have some knowledge not only of purely scientific subjects, of the facts of history on the large scale, and of the results at least of philological inquiry, but also of the power which commercial legislation and commercial enterprise have for altering the distribution of the various vegetable and animal articles of trade; otherwise he may fall, as some have fallen, into the error of supposing commercial results to have been produced by changes in the laws, not of man, but of climate. I make this remark for, among other purposes, the purpose of introducing another remark to the effect that it is much to be regretted a fresh edition of Dureau de la Malle's 'Économie Politique des Romains' should not be brought out in these days: it is a work of permanent value, though it bears the date of 1840. As works of a more exclusively scientific character, but still intelligible easily to persons possessed of a mastery of the rudiments of botany and zoology, and of cardinal importance in researches such as these, I will specify:—

De Candolle, 'Géographie Botanique raisonnée,' 1855.

Unger's "Botanische Streifzüge," in the 'Sitzungsberichte' of the Vienna Academy from 1857 to 1859 inclusively.

Isidore Geoffroy St. Hilaire, 'Histoire Naturelle Générale des Règnes Organiques,' tom. iii., 1862.

K. E. Baer, 'Reden und Studien aus dem Gebiete der Naturwissenschaften,' four octavo volumes which appeared in the years 1864, 1873, and 1876, and contain much of geographical as well as of other interest. This illustrious scientist was for some years from 1839 onwards concerned, together with v. Helmersen, in bringing out at the cost of the St. Petersburg Academy, a periodical, 'Beiträge zur Kenntniss des Russischen Reiches.' In one of the volumes (xviii. 1856, pp. 111–115) of this periodical, a short paper by v. Baer appears, the purport of which is shown by its title, "Die Uralte Waldlosigkeit der Süd-russischen Steppe," "The Aboriginal want of Wood on the South Russian Steppe." This paper was written in supplementation of a paper which had appeared in the fourth volume of the same periodical, 1841, pp. 163–198, with the same object of deprecating a useless and essentially nugatory attempt to make these steppes timber-bearing. From it I will give an extract, partly because it is so characteristic of the manner of the great biologist, and partly or mainly because it shows how pure natural

Beginning at home, let us consider first of all what are the most prominent changes which man has effected in the land-

history can be brought to bear upon political questions and may save a Government from engaging at great expense in chimerical undertakings. V. Baer says, *l.c.*:—"At that time (1841) I had forborne to bring up a piece of evidence in favour of the South Steppe never having been wooded) which is much older than Herodotus; and the present communication has only just the purpose of putting out this evidence, for doing which I have had no earlier opportunity. This piece of evidence is furnished by the squirrels. They are found throughout the Russian empire, so far as trees are found to grow, even in the Caucasus, but with the exception of the Crimea and Kamtchatka, although both these peninsulas have the food which the squirrel wants, and the south coast of the Crimea has it in great abundance. Now from these facts the following conclusion can clearly be drawn, namely, that when these animals reached the southern borders of the forests in South Russia, and the eastern borders of the forests in Siberia, the wide expanse of the open South Russian steppes and also the bare levels northward in Kamtchatka were already in existence. When was it, it may be asked, that the squirrels came to these borders of the forests? I don't know, but that they did come to them before any historical period nobody will be inclined seriously to dispute."

Oscar Peschel, in his 'Neue Probleme der vergleichende Erdkunde,' 1876, p. 1881, adds in explanation of this curious and convincing argument, "A climbing animal dependent for food upon seeds of the trees could not of course travel across the sunny plains of grass; and consequently the South Russian districts in question must have been treeless ever since there were squirrels on the south boundary of the Russian forests; and there can scarcely be any doubt that they were there thousands of years before the time of Herodotus." Oscar Peschel gives no specific reference to v. Baer's works: and v. Baer himself, or his printer, curiously, a wrong one in his 'Autobiography,' p. 644. Nor have I found any reference to it in Professor Stieda's 'Karl Ernst von Baer, eine biographische Skizze,' 1878. I have therefore another justification for the giving of these details, and am glad if I have thus saved others trouble which I had to take for myself, not unhelped, however, herein, by the staff of the Bodleian library.

If Oscar Peschel has made one trifling omission, he has *per contra* made some of the most important additions to geographical and anthropological knowledge, separately and combined, which have been made since the time of Ritter. I need scarcely specify his

'Völkerkunde,' 1874.

'Abhandlungen zur Erd- und Völkerkunde,' 2 vols., 1877–1878.

'Physische Erdkunde,' of which three fascicles have appeared in the present year.

The general principles to be found expounded in the works above specified, have found a practical application in the particular question, Are the countries along the shores, and especially the eastern shores, of the Mediterranean to be looked upon as having been exhausted by man's interference with them in the way of agriculture, and so robbed of any chance of political rejuvenescence? And with this question is connected that which asks whether any perceptible change of climate has been effected in the same regions by the same agency. The literature of this controversy, which has been carried on obviously enough by partisans filled at least on one side with political bias, is, if we give only the most important memoirs, not very extensive, and may perhaps usefully find a place here.

C. Fraas, in his 'Klima und Pflanzenwelt,' 1847, takes the pessimistic view, which

J. P. Fallmerayer, in a review published in the same year apparently, and republished in his 'Gesammelte Werke,' 1861, ii. 462, endorses with a bitter readiness.

scape, so far as the landscape is made up of organic elements, of our own country. I have not undertaken, and shall not attempt to speak of such changes as those which the embankment of our rivers has effected, referring those of my hearers who may feel an interest in this particular change, to Sir Christopher Wren's disquisition upon the subject, which may be found with very much else very well worth reading in the 'Parentalia,' p. 285. But I have to say that changes of proportionately equal magnitude have been effected in our landscape by the interposition of man in the way of introducing into it trees which, though now naturalised, are demonstrably not indigenous to our soil. The most striking of these changes are those which have been effected by the introduction of the common elm, *Ulmus campestris ;* next, if indeed not equal in

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C. Fraas, in the 'Geschichte der Landbau und Förstwissenschaft,' München, 1865, had the opportunity of again expounding his views, p. 350 *et passim*, in his account of Liebig's views. Those views are to be found in

Liebig, 'Natural Laws of Husbandry,' Eng. Trans., 1863, and in his 'Chemische Briefe,' the ninth edition of which bears date 1878.

Oscar Fraas, possibly or presumably a relative of C. Fraas, from certain passages in his 'Aus dem Orient,' 1867–1878, would appear to be of similar views to those of his namesake ; he speaks (vol. i. p. 213) in defiance of Arago's views, as expounded in 'Œuvres,' vol. viii., 'Notices Scientifiques,' vol. v. ed. 1859, p. 222, of a "veändertes Clima der Nilländer," and says (p. 215), what will be read with some surprise by Indian officials, "Heutzutage erlahmt die Energie selbst eines kräftigen Europäer's unter der Sonne von Egypten . . . man erschlafft, wird träge und faul, man fängt an zu bummeln!' An excellent answer to all this is given by

Theobald Fischer, 'Beiträge zur Physischen Geographie des Mittelmeerländer, besonders Siciliens,' 1877, p. 154, *usque ad finem libri*, p. 167.

Fr. Unger, in his 'Wissenschaftliche Ergebnisse einer Reise in Griechenland,' 1862, has dealt similarly with this question at the conclusion of his small but excellent memoir, pp. 187–211.

The views of Victor Hehn, and those of the recently deceased botanist and author of an authoritative work, 'Die Vegetation auf die Erde,' 1872 (translated into French in 1877 by Tchihatcheff), viz. Grisebach, may be given in the words of the latter, when reviewing the former in the 'Göttingen gelehrte Anzeiger,' 1872, xlv. p. 1767. With these views we agree. They run thus :—"Mit Recht verwirft er die Meinung dass die klassischen Länder erschöpft seien und einer Erneuerung ihrer ehemaligen Blüthe keine natürliche Grundlagen mehr böten. Er trifft das Wesen der Sache, indem er sagt, dass ihr Klima, im Grossen aufgefasst, nicht vom Boden und seiner Vegetation, sondern von 'weitgreifenden, meteorologischen Vorgängen' abhänge, die durch ihre geographische Lage bestimmt, 'von Afrika und dem atlantischen Meere bis zum Aralen und Siberien reichen.' Ebenso muss man sein eingehendes Verständniss dieser Frage anerkennen, wenn er im Bereich der Agrikultur-Chemie sich gegen die Ansicht ausspricht, dass der Boden Südeuropas durch seine alte Kultur an mineralischen Nahrungsstoffen erschöpft sei. Wie die lombardische Ebene durch die Alpenflüsse mit frischen Silicaten und Kalksalzen gespeist wird, so liefern die so manigfaltig gegliederten Gebirgeketten, welche die Länder am Mittelmeere erfüllen, aus dem Innern ihrer Felsmassen unerschöpfliche und durch das fliessende Wasser stetig ausgebreitete Vorräthe, um die Erdkrumen der Thäler und Tiefebenen immer wieder auf Neue zu befruchten."

magnitude, those effected by the introduction of certain coniferæ; and then, at a long distance behind as regards numerical importance, those effected by the introduction of the horse-chestnut and the sycamore. I do not of course forget that such trees as the walnut, and a host of other trees which are now entering into the picturesque, if not into the economical aspect of Great Britain, are as foreign to our soil as their names remind us they are; but I am not delivering a treatise upon our forest trees, and I shall confine myself within the limits which the three or four trees or orders of trees specified in the preceding sentence mark out for me. Let me begin with the simpler cases, those of the horse-chestnut and the sycamore first. I should indeed be ungrateful, living as I do within such easy sight of the beautiful, if not unrivalled, horse-chestnuts of New College Gardens, if I did not express my sense of gratitude to the men who introduced that tree into England. There is, of course, as little question as to its non-indigenousness as there can be as to its beauty. Botanists, however, differ as widely as possible as to what its native land may have been. I have not been able to satisfy myself that Hehn, *l.c.*, pp. 348 and 457, is right in saying that we owe the introduction of this tree into Europe to the Turks. All but certainly this was not the case if D. Hawkins, as cited by Fiedler in 'Reise durch alle Theile des Königreiches Griechenlands,' 1840, vol. i. p. 649, is right in saying that this tree grows wild on Pindus and Pelion. There are not wanting species on either side of the Greek Archipelago which no naturalist would divide or bifurcate, nor, I imagine, has the Greek Archipelago existed in its disconnecting discontinuity as long as the species *Æsculus hippocastanum*.

The sycamore is another undoubtedly non-indigenous tree, but it is thoroughly naturalised and abundant in certain parts of England; and notably in the Lake District it forms a very characteristic feature of the landscape, when it is massed round the equally distinctive old farm-houses. In the Lake District its leaves have assumed a somewhat darker colour than they ordinarily bear in the southern and midland counties; and its bark often exhibits what some naturalists would call a mimetic analogy to that of its fellow-countryman the Oriental plane. The sycamore has yet other claims upon our attention, as the readiness with which its seeds take root might have long ago destroyed, even to the eyes of the least observant, that *idolon theatri molestissimum et ineptissimum* which taught that if a plant could be proved to

be non-indigenous in a country it was useless to expect it to flourish there.*

I will now turn to the Coniferæ. In another place,† I drew attention to the well-known and universally accepted fact, that till comparatively recent times the Scotch fir (*Pinus sylvestris*), the yew (*Taxus baccata*), and the juniper (*Juniperus communis*), had been the only representatives in these islands of the natural order *Coniferæ*. I did not dwell then, and I will not dwell now, upon the greatness of the difference which has, in the last three hundred years, been effected in the general aspect of our country by our successive importations of the spruce, the larch, and the silver fir from other European countries, and the multitudinous trees belonging to the same order from North America, from North India, from California and Mexico, from Japan, from China, and from Chili, the names of which "plants of the fir tribe suitable for the climate of the United Kingdom, cultivated by . . . . nurserymen and seed merchants," fill up some sixty-six pages in a sale catalogue now before me. Any traveller, by rail or otherwise, can appreciate the greatness of the alteration which has been effected by man on nature, if he will but bear in mind the three trees just specified, and recollect as he sees the silver fir spreading out with its airy interspaces in the sky-line, and the larches and spruces clothing the hill-side in acres upon acres, that these trees were as little known to the untravelled Englishman of the times of the Tudors as were the "Weymouth" pine, the Deodara, the Wellingtonia, or the Araucariæ. The statesman, indeed, can read something of the political and commercial history of this kingdom in the trees which speak of the various countries, farther distant apart from each other than are "China and Peru," with which England has successively come into *rapport;* and the changes which he has suggested to him are scarcely, if at all, less complicated than those which the naturalist can show to have been similarly set up in the world of lower life represented by birds and insects. Since I wrote as above (*l. c.*)

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* For an example of the operation of this notion, so opposed to the most obvious facts, see 'Viti (Fiji), by Berthold Seemann,' p. 426, where, apropos of the statement "the cotton plant is not indigenous in Fiji," we have the following note:—

"Most of the newspapers took this fact to be a serious drawback to the successful cultivation of cotton, quite forgetting that cotton is not indigenous to the United States and many other countries in which it flourishes. I made exactly the same statement (cotton is not indigenous in Fiji), but added that notwithstanding, it had become almost wild in some parts, so well is the country adapted for its growth.—B.S."

† 'British Barrows,' p. 724.

I became acquainted with an article on "Coniferous Trees" in the October number of the 'Edinburgh Review' for 1864, to which I would beg to refer my hearers for a detailed and very interesting account of the successive successful acclimatisations of members of this natural order; and upon the ground thus sufficiently occupied I will not encroach. It is not uninteresting, and not entirely irrelevant either, to observe that Great Britain and Ireland were both richer in Coniferæ in recent geological periods than they have been since those times down to those of the Stuarts. In the sunken forest at Cromer, in Norfolk, in a deposit* of a period immediately preceding the glacial, we find the spruce fir represented, together with nearly all the rest of the scanty list of really indigenous post-glacial English trees. In the Cromer forest we find the spruce represented, together with the Scotch fir, the yew, the oak, the elder, the birch, and the blackthorn. The ash has somehow failed to join itself on to this company; but we see it forming one of it, though the spruce in its turn is absent as well as all other trees, in many small copses or thickets in out-of-the-way parts of this country. Such, for example, are many mountain-lime-stone headlands in parts of the Principality, where the Welshman—in spite of the traditional hatred for trees which his race, like some other ancient races, as, for example, the Spanish, is said to entertain—has allowed the ancient flora to remain, and left it unmixed with foreign importations. The intervention of the glacial period will easily account for the wiping out of the spruce from the list of post-glacially indigenous British trees; but it is not so easy to explain how it has been that the silver fir (*Abies pectinata*), which is found in the Scottish peat, was absent from at least historic Britain till the year 1603; and that the *Pinus mughus*, the *Tæda* of the Romans, should be found in the peat-bogs of Ireland, and should subsequently have become as thoroughly extinct there as the Irish elk, *Cervus megaceros*. On the other hand, it is not difficult to understand how it has been that the Scotch fir, with characteristic pertinacity and hardiness, followed up the retreating glacial forces more closely than even the "Norway" spruce; for at this day it propagates itself, either by self-sown or by squirrel-sown seeds, much more surely and widely than does this equally or more than equally hardy tree.

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* See 'Rudiments of Geology,' by Samuel Sharp, F.S.A., F.G.S. 2d ed. 1876, p. 169.

I must not leave the subject of the Scotch fir without rectifying an error relating to it which various writers,* from the time of Cæsar's Greek translator down to those of Evelyn and of myself inclusively, have fallen into when writing about it. Julius Cæsar, in an often-quoted and as often mistranslated passage,† says of Britain, "Materia cujusque generis, ut in Gallia, est *præter fagum atque abietem;*" and these words are ordinarily taken to mean, "There is wood of all kinds to be found in Britain, as in Gaul, *except* the beech and the fir." Poor old Planudes of course blundered, as a Constantinople monk of the fourteenth century was sure to blunder, "reaping," as Mr. Philip Smith has remarked apropos of his edition of the Anthology, "the reward which often crowns the labours of bad editors who undertake great works;" and the words of Julius appear, *l. c.*, in the following Greek dress: *πᾶν εἶδος δὲ δένδρου παρ' αὐτοῖς, ὡς ἐν τῇ Γαλατίᾳ πλὴν φηγοῦ τε καὶ πεύκης, φύεται.* Evelyn, speaking of the fir (p. 139, *l. c.*), uses the following words: "which with this so common tree (the beech) the great Cæsar denies to be found in Britain; . . . . but certainly from a grand mistake, or rather, for that he had not travelled much up into the country." Hasted (*l. c.*), in 1771, translates the words thus: "This island has every kind of tree the same as Gaul *except* the fir and the beech. Some scholars hold still that this is the right way of translating the words. But my friend Mr. J. P. Muirhead, the author of the Life of James Watt, pointed out to me that *præter*, in the language of Julius, does by no means always mean *except*, but means sometimes simply *besides*. For example, when ‡ Ariovistus stipulates that Cæsar and he should meet and confer on horseback, each bringing ten assessors with him, Cæsar's words run thus: "Ariovistus, ut ex equis colloquerentur, et *præter* se, denos ut

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* Planudes fl. 1327 A.D. See p. 46 of Appendix to Cambridge edition of Cæsar's Works, 1706.

Evelyn, 'Silva, a Discourse of Forest Trees delivered in the Royal Society, Oct. 19, 1662,' Ed. Hunter, 1776, p. 139.

Hasted, 'Phil. Trans.,' vol. lxi., for year 1771, pt. 2, 1772, p. 166.

De Candolle, 'Géogr. Botanique,' pp. 154, 689. 1855.

Johns, 'Forest Trees of Great Britain,' p. 42.

Rolleston in 'British Barrows,' p. 722–724. To do myself justice, I did not err so widely as my companions in this matter. I was as ignorant of Latin as they; but I accused Julius of only one blunder, while they accused him of two. If I had really believed that "Cæsar doth not wrong but with good cause" it would have been better for me. As it was I made a poorish "explanation" for Julius as regarded the *abies*, but confessed that I felt some doubt as to the accuracy of his statement as to the beech.

† De Bello Gallico, v. 12. ‡ Ib., i. 43.

ad colloquium adducerent, postulavit." And we may learn from this single passage that it is as well to be quite sure of an author's meaning before we impute "a grand mistake" to him, especially if he happen to be really a grand man. I may add that Cicero, in a single passage in the same connection as one which I shall have to refer to shortly for another purpose,* uses the word *præter* in both the senses, *except* and *besides*. His words, telling us how Verres bestowed himself, *somni, vini, stupri, plenus*, run thus: "Vir accumberet nemo *præter* (except) ipsum et prætextatum filium; tametsi recte dixerim *sine exceptione* virum quum isti essent neminem fuisse . . . . Mulieres autem nuptæ nobiles *præter* (besides) unam minorem Isidori filiam, &c. &c. Erat Pippa quædam uxor . . . . Erat et Nice fœmina." My own natural history studies had familiarised me with the line of Plautus, Stich., 3, 460:—

"Mustela murem ut abstulit *præter* pedes"—

and should have shown me that the *local* meaning of *præter* is also its *general* meaning, and that it retains the idea of "by the side of," even when by the aid of a negative, expressed or implied, it comes to be more conveniently translated by the word "except."

It would be perhaps showing as much over-anxiety to vindicate Cæsar's accuracy, as has been shown of over-readiness to impute inaccuracy to him, if I were to point out, after Parlatore,† that Cæsar might have been familiar with the Scotch fir itself, *Pinus sylvestris*, even in Italy, to say nothing of the other European countries traversed by his victorious eagles. An historian who was or was not a professed botanist, might without any sensible man blaming him, speak now-a-days of all the common pines, "Scotch," "umbrella," "cluster," &c., as "pines"; my present belief is that Julius would similarly have spoken of them all as *abietes*, and would probably have included the "firs" proper under the same name as these "pines." But I wish hereby to retract the suggestion *l. c.* as to his having meant the silver fir, *Abies pectinata*, by the word *abies*, in the much vexed passage in question; though that suggestion was made in the best possible spirit, and is scientifically unanswerable as against those unhappy persons who feel malevolently towards Cæsar, which I never did, and are at

* X. in Verrem, Act. ii. lib. v. 31, 81.

† 'Etudes sur la Géographie Botanique de l'Italie,' p. 37, 1878.

the same time, as I was when I made that suggestion, unable to translate him correctly.*

I have yet a couple of points to mention regarding the use which man has made of the Coniferæ, and the alteration which he has in comparatively recent times effected, firstly by, and secondly upon, the distribution of this order of trees.

The same number and the same article on Coniferous Trees in the 'Edinburgh Review,' October, 1864, gives the interesting history of the recovery by Brémontier and his followers, from the condition of blown sand, of the vast area (100,000 acres) in the Landes of Gascony, which should in justice to him bear his name. His agency was the "cluster" pine, elsewhere called the "pouch" pine, the *Pinus pinaster* of the botanists.† The

* Mr. J. A. Froude cannot be accused of any want of loyalty to the subject of his 'Biography'; still we may say to him

Nec te tua plurima, Pentheu,
Labentem pietas, nec Apollinis infula texit—

For in that work, 'Cæsar, a Sketch,' 1879, I read, at p. 271, of Britain when invaded B.C. 54, that "the vegetation resembled that of France, save that he saw no beech and no spruce pine." Cæsar must have seen the beech, but not even Cæsar could have looked either far enough forwards or far enough backwards to have seen the spruce-fir growing in Britain.

† The pine employed by Brémontier is the *Pinus maritima* of botanists; it is, however, as nearly allied to the *Pinus halepensis* as the two cedars *Deodara* and *atlantica* are to each other. And I used a picture enlarged from a drawing of Unger's ('Wissenschaftliche Ergebnisse,' p. 88) of a "Pinus halepensis," growing in Eubœa, to show the general habit of the tree which had proved so useful in the French Landes. It may be well, for my own credit at least, that I here explain that I had with me, and suspended in the lecture-room, a number of pictures in illustration of my subject. These I will herewith enumerate, stating the points they were intended to make intelligible to the eyes, thereby sparing the ears, of those who honoured me by coming to my lecture. I had with me—

Firstly, the picture just referred to, which was intended primarily to illustrate, as were some of the other pictures, the mischievous action of the goat, underwood being almost entirely absent; two goats being drawn browsing upon such shrubs as were left, and keeping them down to a line corresponding with what Ruskin calls in this country, where the old legal rule, *bidentibus exceptis*, still happily holds good in practical pasturage, the "cattle line." The great mass of the picture was occupied by the tall pines in question, and the bare, barren, and sunburnt native rocks, which irrigation and the prohibition of goats might cover with figs and olives.

Secondly, two pictures from Lepsius's Egyptian 'Denkmäler,' Abtheil iii. 46, iv. 3, and iv. 126, represented goats and men allied in the unholy task of destroying the palm-trees of an enemy's country. In one of these pictures the goats had assumed the same arboreal habits which they are drawn as exhibiting in Hooker and Ball's 'Morocco,' p. 97, in the argan tree. This picture was also shown enlarged by permission of Sir Joseph Hooker. One of the pictures from the Egyptian monuments was of the time of the 12th dynasty, and therefore, Professor Rawlinson informs me, as early, according to Wilkinson, as from B.C. 2020 to B.C. 1860, or even, according to Brugsch, as from B.C. 2378 to B.C. 2200. It is of course important to know that the palm was so early as this a familiar object to Egyptian eyes, when, as I further learn from Professor Rawlinson, "the earliest date-palms represented on Assyrian monuments belong" to no earlier a date than

resinous and other products of this plantation form now an important article of commerce; their sale and the planting of more of the previously barren, shifting, sandy waste, received a great impulse, as did many alien interests, by the interruption to American imports caused by their great Civil War,* and they occupy a large space in some of our various public exhibitions of economic products. Some little uncertainty appears to hang about the question as to the person to whom the chief

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B.C. 833 to B.C. 858; and that even in Babylonia, where they now flourish far more than in the region corresponding to Assyria proper, the palm-trees have not monumental evidence for an earlier date than B.C. 1500. A cylinder from Babylonia, of uncertain but not earlier date than this, is figured in Professor Rawlinson's 'Ancient Monarchies,' vol. iii. p. 23, 2nd edition. These dates furnish something of an argument in favour of Unger's suggestion that the palm may have had its original home in Upper Egypt; and may make it seem more probable that the Assyrians learnt from the Egyptians, than the Egyptians from them, the art of cultivating this tree. Kämpfer ('Amœnitates Exoticæ,' p. 714), declares himself to be, as indeed the inhabitants of Egypt themselves were, of opinion that Arabia was the native home of the palm, and he dismisses the claims of a more westerly origin in the four plain words, *nam Africam non moramur.* We shall, however, go hereafter in detail into the claims of the "Dark Continent."

Thirdly, a picture of the gathering in of the date harvest in Persia, taken from Kämpfer's book just referred to, which was used to illustrate in connection with certain reports of the formation in Algeria of date plantations in regions previously barren (see Reclus, 'Earth,' i. p. 98, Eng. trans., 1871; Laurent, 'Mémoires sur le Sahara,' p. 85, 1859, *cit.* Marsh, *l. c.* p. 482) the power of man for producing happiness and enjoyment in localities previously but sandy, thirsty deserts.

Fourthly, a picture enlarged from one given in Martius' 'Historia Naturalis Palmarum,' iii. 1823–1850; vol. iii. pl. 120, of the ruins of the ancient Agrigentum, with their modern surroundings. It is thus described by Martius himself, p. 249, note:—"Chamærops humilis, alia depressa, alia elata octodecimpedalis, in agro Agrigentino, antiquissimis ruinis celebri, depicta a Cl. Frid. Gaertner, architecta. Muros conspicis magnifici templi quod Jovi Olympio olim consecratum, nunc inopis palmæ, opuntiæ, et agaves domicilium factum est. Junonis Lucinæ, Concordiæ et Herculis templa diruta remotiores tenent colles." It would be difficult, except possibly by the introduction of the orange and olive into the picture, to give a more instructive view of a Mediterranean landscape as altered by man's interference. The ruins of what Pindar called the fairest city raised by earthly men, of what Virgil called "maxima longè mœnia," speak to man's power for destruction; the agave and the prickly pear tell of his discovery and utilisation of America; the fan-palm with its spreading, far-reaching roots and suckers stands as it did in the far-off times when the priscan inhabitants of Sicania fed upon its roots, as Cicero (X. in Verrem, Act. ii. lib. v. 38, 39) suggested they did before Ceres gave them in that very island the gift of Cerealia, and as it did in the much later days when Verres, by malversation and maladministration, reduced Roman sailors on the shores of what was called the granary of Rome, and was but a few days' sail from Rome, once again to pacify hunger by feeding on that characteristic Mediterranean plant. The importance which plants imported from the New World have assumed in the Old, forms a subject by itself; of the two just specified, besides their other applications, we learn from Admiral Smyth's still unsuperseded 'Memoirs of Sicily and its Islands,' 1834, p 17, that they "form impenetrable palisades for fortifications, and in the plains they present very serious obstructions to the operations of cavalry."

* Lavergne's 'Économie Rurale de la France,' ed. iv., p. 296.

credit of this work, which has been compared, and not unjustly, with that of the recovery of Holland from the empire of the sea, is really due. The 'Edinburgh' reviewer assigns it, apparently with good grounds for so doing, to M. Brémontier, and to a period beginning with the year 1789. Professor Koch,* whilst mentioning (*l. c.* p. 293) Brémontier, couples with his name that of M. Desbiry, but adds that the greatest credit of all is due to M. Ivry, of Bordeaux, whom he visited himself in 1864, on his own plantations at Pian, and found to be still a vigorous man though eighty-six years of age. Professor Koch pays a meed of praise to the late Emperor Louis Napoleon for his exertions in the same direction and locality; and it is, I think, to another name connected with the Second Empire that the credit is, rightly or wrongly,† assigned, of having enabled the wastes of Gascony to produce and to boast of the heterogeneous multitude of useful products displayed in our industrial exhibitions as being now manufactured out of the pine imported thither from Corsica.

It is in this same many-sided connection interesting to note, if we in these recent centuries have re-introduced several conifers which were indigenous, like the spruce, in the immediately Pre-glacial, or like the silver fir, in the still later period of the deposition of the peat, but perished either before or during the Prehistoric human period,‡ and if we are still actively employed in adding to the number of species of this natural order in our landscape by importation from every quarter of the globe, from China to Chili, in proportions represented by a descriptive catalogue of more than 400 "plants of the fir tribe suitable for the climate of the United Kingdom," we have, I think it may be shown, also considerably diminished the numbers of one of the few of our native representatives of

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* Professor Koch, of Berlin, who seems to consider the planting of the vine to be the climax of attainment in the way of utilising a previously desolate region, writes thus of it, after visiting the spot: "Weniger möchte es bekannt sein, dass unsere beliebten rothen Bordeaux-Weine ebenfalls in diesem Departement der Haiden wachsen, und dass der Boden vor nicht sehr langer Zeit hier erst für die Weinfelder urbar gemacht wurde. Die guten Weine wurden früher auf dem gegenüberliegenden Ufer der Gironde gewonnen," p. 294.

See also Clavé, 'Études sur l'Économie Forestière,' 1862, cited by

Marsh, *l. c.*, pp. 595–606.
Reelus, 'Earth,' Eng. trans., i. 82.
Edmond About, 'Le Progrès,' chap. vii.
Lavergne, 'Économie Rurale de la France,' 1877, p. 297 *seqq.*

† Wrongly very likely—in England we are content to ascribe the invention of the safety lamp to George Stephenson.

‡ See De Candolle, 'Géogr. Botan.' 807.

this order. This is the yew (*Taxus baccata*). It is a tree which, though valuable to the turner, nevertheless grows too slowly to pay well in these days when the spirit which makes haste to be rich, makes a "vegetable manufactory" of the hill-sides of our Lake District (to use Wordsworth's prose), by covering them with the rapidly growing larch—to say nothing of the severe competition, even as a wood for the turner, to which the beautiful woods of New Zealand and other southern colonies now subject it. Formerly matters stood somewhat differently, when it could be said:—

> "England were but a fling
> But for the eugh and the gray goose wing."

But when the invention of gunpowder, and the application of it to the science and art of projectiles, "put me a caliver into Wart's hands," the principal *raison d'être* of the yew-tree was destroyed. A man who drew a good bow, even if he drew it at a venture, had needs have "the limbs, the thews, the stature, bulk, and big assemblage" of the men who won the battles of Agincourt, of "Cressy red and fell Poitiers;" and if he were to put his arrows into the clout, he had needs have a steady and well co-ordinated eye, as well as well co-ordinated and strong arms, to be effective. Such men were sent on many a campaign from England; and for the commencement of such campaigns, before the hardships of war had impaired the soldier's condition, no more efficient man-slaying machines could, when fair stock was taken of the relative deadliness of the available weapons, have been conceived of, till the rifled musket was discovered. But even English archers were liable to the influence of short rations, hard work, and weather; and as campaigns were not always settled in a few weeks, the firelock, a weapon which Feeble and Wart, even if they were not their "craft's masters," could, under the supervision of that admirably qualified musketry instructor "Master Corporate" Bardolph, learn in a few weeks to use with as much effect as the most stalwart of tournament champions, displaced the bow and arrow, though not entirely till after the wars of the Roses. This displacement seems to have entailed the disappearance from many and many a locality of lines and avenues of yew-trees, of which here and there we still have a few representatives left us, and which, in such places as the combes in chalk districts, form in the way of contrast, and indeed also intrinsically, such a pleasant and interesting feature of the landscape.*

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* Having above quoted Mr. Hasted to his disadvantage, I wish to make some compensation to his memory by here quoting a sentence of his with which I en-

Of the vastness of the change which the introduction of the common elm (*Ulmus campestris*) into Britain has produced in the landscape, any one who will count and compute the numbers of the trees visible in any one of our midland counties at one view will readily convince himself. It has, I think, been said already by some one, and may now be said again, that previously to the development of our railroad system all the experiences and sensations of the great majority of our rural fellow-countrymen were gained within an area limited by a horizon bounded by an uninteresting row of these hedgerow trees. Of the evidence for the belief that this tree was really imported by the Romans, and not known here previously by the Britons, however familiar it be to us Saxons, I have spoken elsewhere.* To the grounds for that belief, there stated, let me here add the authority, firstly, of the Cromer forest, in which no elm (not even the wych elm, of which I do not here speak) was found; and secondly, of Mr. Bentham,† who says of it: "In Britain it is the most frequent elm in central, southern, and eastern England, but in the north and the west only where planted. It is, indeed, doubtful, whether it be really indigenous anywhere in Britain."

Man's increasing command over the inorganic world has, in yet another way and in another time, and that our own, very powerfully modified the botanical world around him; and as this particular instance of the efficiency for good and evil is a matter of some practical consequence, and one which is still a subject of discussion and comes into the sphere of legislative interference, I will mention some of the facts concerning it. I refer to the effects which the by-products of certain manufactories exercise upon the vegetation of the districts in which they are situated. One of the most interesting papers I have ever had the good fortune to listen to was one read by my friend Mr. Robert Garner, F.L.S., at the British Association Meeting held at Newcastle in the year 1863, and printed in the Report for that year at p. 114, as also in his 'North Staffordshire Tracts,' p. 10, reprinted from the 'Staffordshire Advertiser' of 1871. His words run thus:‡ "With respect to

tirely agree, but which I had not read when I wrote as I have done in the text, relatively to the yew. It is the concluding sentence of the already quoted paper in the 'Philosophical Transactions' of 1771, and runs thus: "Whoever has been much acquainted with the woods and tracts of ground lying on our chalky hills will surely never contend that the yew is not the indigenous growth of this country."

* 'British Barrows,' pp. 721–722.

† 'Handbook of the British Flora,' p. 746.

‡ British Association Report, *l. c.*

chemical impurities of the air, different plants have different susceptibilities for such influence, and the greater or less impurity of the atmosphere may indeed be shown from the effects on plants. Thus the rhododendron will flourish in an air fatal to the common laurel; wheat will luxuriate where a holly or oak will die. Some plants which appear naturally to luxuriate in the coal strata—as the oak, holly, or some ferns—die when the mines begin to be worked. Fortunately, annuals suffer least; for instance, corn and wheat do well where nothing else can, and perhaps the exhalations in question may even tend to ripen them. An increasing deterioration of the atmosphere in towns and mining districts may be estimated by means of plants as follows:—1. In the smallest degree of impurity, trees are destitute of the leafy lichens, and Ericæ, the Scotch fir, and the larch die. 2. Next, the common laurel, the Deodara cedar, the Irish arbutus, the laurustinus, and the yew die. 3. The araucaria, the thuia, the common cedar, the mezereon, and the Portugal laurel die. 4. The common holly, the rhododendron, the oak, and the elm die. 5. Annuals still live, and the almond, poplars, and many roses thrive, fruit-trees are barren, peas unproductive. 6. Hieracia, *Reseda lutea*, the elder, some saxifrages and sedums, with many syngenesious and cruciferous weeds, still luxuriate."

The mountain and moorland plants are most, just as the nettle, the elder, the shepherd's purse, the sow-thistle, are least susceptible of antihygienic influences; the former as well as the latter set of organisms showing the influence of habitnation, both alike being unable to "leave their place of birth; they cannot live in other earth," or rather air. The presence of the former would be an infallible sign on the hygienometer; the presence of the latter encourages us not to despair.*

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* That man has sometimes the power of undoing the mischief he has done, even by the somewhat perilous, and often mischievous, action of legislation, a *précis* of the evidence taken and given before Royal Commissions on noxious vapours, and embodied in a Blue Book of last year's (1878) date, will abundantly show. This *précis* I take from a letter signed "Edward Sullivan," in the 'Times,' December 2, 1878. In this letter Mr. Sullivan says, in summing up for the defence of the alkali manufacturers:—

"As regards the injury done to the picturesque value of land by alkali manufacturers, I am afraid there is no doubt they must plead guilty. In some cases, especially in that of Sir Richard Brooke, the damage is most distressing; but there is a concurrence of evidence from Widnes, Weston, Runcorn, St. Helens, Flint, and Hebburn, that during the last four years, since the passing of the Alkali Act of 1874, the damage has very much diminished, and that in districts where the number of works has not increased the present damage is inappreciable.

M. de Lavergne, in his work on the 'Économie rurale de la France depuis 1789,' does not mention the name of any indi-

"At page 10 of the Report, Major Cross states he lives a mile and a half from the centre of Widnes. Since the passing of the Act of 1847, he had a fair crop of fruit, and roses and flowers grew luxuriantly.

"Page 11 (Ruucorn). Mr. Wigg stated he had planted 1800 trees round his house, about a mile and a half from the nearest works, 'which were all growing very well indeed.'

"Page 11 (St. Helen's). Mr. Gamble produced two photographs of a plantation 1000 yards from the works, one taken in 1862 for the use of the Lords' Committee; the other, taken in 1876 at the same spot, showing a manifest improvement in growth and condition of trees.

"Page 11 (Flint). Mr. Muspratt stated that subsequently to the Act of 1874 vegetation was not affected at a greater distance than 200 yards. He instanced gardens containing elms and other trees flourishing within 500 yards, and old oaks growing luxuriantly within a mile of his works.

"As regards the depreciation in agricultural value caused by alkali works, a great deal is to be said.

"Pages 8 and 9 of the Report. Major Cross, 'for seven years a member of the Widnes Local Board, and five years its chairman,' states the average selling value of land in and about the present site of Widnes in 1854 not to have exceeded 50*l.* per acre. The greater part of the site of the town and works of Widnes was bought in 1860 at from 30*l.* to 40*l.* per acre. Since that time favourable sites within half a mile of Widnes have been sold at the rate of 1600*l.*, 2400*l.*, and 4800*l.* per acre.

"Land at Ditton, a mile and a half from Widnes, which in 1858 was not worth 60*l.* per acre, was sold for 300*l.*, and of late particular lots in Ditton and Cronton, the one being two miles and a half, the other three and a half, from Widnes, were sold at 600*l.* per acre. These purchases were made for building cottages, villas, &c. As regards letting land for agricultural purposes, Major Cross adduced several extracts from the poor-rate books, showing that the estimated rental of land situated near the works had steadily and often largely increased. For instance, at Cuerdley, on which the principal Widnes works are built, and which contains 1573 acres, mainly the property of Sir Richard Brooke, the estimated value of agricultural land per acre was, in 1861, 1*l.* 12*s.* 7*d.*; 1871, 1*l.* 16*s.* 3*d.*; 1857, 2*l.* 3*s.* At Ditton the value of land for agricultural purposes had risen during the same period from 1*l.* 13*s.* per acre to 3*l.* 5*s.* 7*d.* (page 9).

"Major Cross meets the allegation of the deteriorated value of farm produce, by stating that in the near neighbourhood of Widnes milk sells at from 3*d.* to 4*d.* a quart; hay at from 6*l.* to 8*l.* per ton. He states he has known hay and straw grown within a mile of Widnes fetch the highest price in the Liverpool market, and that in 1875 the Manchester and Liverpool Agricultural Society gave to the tenants of a farm of 80 acres within two miles of Widnes the prize for the best cultivated land.

"Page 10. 'Mr. Wigg, while admitting the damage done in past times to Sir R. Brooke's estate, asserted that the value of his property, through the proximity of the alkali works, had enormously increased.' That estate consists of 1200 acres on the Lancashire side and 5600 on the Cheshire side; and Mr. Wigg stated his reason for believing that the selling value of the Lancashire estate was at this moment greater than that of the two estates together in 1860.

"Mr. H. Beswick and Mr. H. Linaker, both agents to important estates near the works at Runcorn, Weston, and Widnes, and long and intimately connected with the district, bore witness to the same effect as Major Cross. Both, while admitting occasional visitations from gas, and consequent injury, declare that they have never had any difficulty in finding suitable tenants at invariably increased rates. 'I can more readily,' says Mr. Beswick, 'let land at better rents within 5 or 6 miles of Runcorn than I can on other portions of Lord

vidual as having been specially concerned in the great and successful undertaking of redeeming the Bordeaux Landes. But his remarks upon it* have so much of value in them, and touch upon so many of the multitudinous sides—historical, political and economical—which this enterprise, and other State-supported enterprises, present to us when we study them in

Cholmondeley's estates 20 miles away. . . . Within the last few years I have refused 4*l.* a statute acre for land for agricultural purposes close to Widnes works.' 'The rentals on the property in the neighbourhood of the works under my care have gradually increased during my time, but they have increased more rapidly during the last few years. The rental of two farms at Rock Savage, near to the Weston works, has increased from 101*3l.* in 1863 to 150*3l.* in 1876 and 1877. I regret that I cannot say the same for estates under my care at the distance of 20 miles." (Page 11.)

"I think, therefore, I may fairly assert that when the Report on Noxious Vapours, 1878, comes to be fairly examined and discussed, as most certainly it will be where so extensive an industry is at stake, it will prove that, great as may be the nuisance complained of by the landowners of Lancashire, they have in the great majority of cases received a very substantial set-off in the increasing value of their land, both for rental and for sale.

"The alkali industry is a necessity in a manufacturing country. If it is an evil, it is a necessary one. Sulphuric acid, the base of all alkali products, may be called the heart of all manufacturing industries. The consumption of it is the surest gauge of their condition. There is scarcely a manufactured article in daily use that is not more or less dependent on it. To enhance the cost of its production by hasty or ill-judged legislation, would enhance the cost of half the industrial products of the country. It is not the greed of manufacturers that has increased the number of alkali works, but it is the increased trade of the country that has demanded an increased supply of an indispensable element of production.

"If new works had not sprung up at Widnes or St. Helens, they would certainly have sprung up elsewhere. It is to be regretted that so many works have congregated at Widnes and St. Helens. The consumption of coal alone, a million tons at the former and a million and a half at the latter annually, would of itself cause great nuisance to the neighbouring districts; but who, pray, is to blame for this evil? Not, certainly, the manufacturers who bought and leased the land offered them by the landowners, but the landowners who offered it.

"Complaints of injury done to trees, to the picturesque value of ornamental property, do not come with very good grace from the very proprietors who have sold and leased contiguous land at very high prices, for the expressed and avowed object of erecting and extending the works they now wish to destroy.

"Sir Richard Brooke, whose name most frequently occurs in the report, and who is undoubtedly the greatest sufferer in the picturesque value of his estate, has within the last few years leased land immediately opposite his house, at a very high rental, for the erection of alkali works and the deposit of alkali waste; and, I understand, has hundreds of acres more to be let for the same purpose: nor is he by any means the only landowner who has let and sold land expressly for the erection of alkali works.

"There is a general desire among alkali manufacturers to minimise the nuisance and injury caused by these works. Recent legislation has undeniably tended to that result, and any further legislation in the same direction that is reasonable and practicable will, I know, receive their hearty support; but it will be a fatal mistake if a somewhat one-sided statement of local grievances should cause any hasty legislation that would destroy an industry that is absolutely indispensable to the manufacturing prosperity of the country."

* Pages 297–300.

their entirety, that I think I may be allowed to quote them as they stand. After touching on the dangers which pines more than other woods are exposed to from the sparks which the railway train so readily and so fatally scatters in such dry and parched districts; but omitting the not inconsiderable, even if not complete, safeguard which the planting of lines of the *Robinia pseudacacia* on either side of the railroad would furnish; which he might very well have added, as this tree does such good service in this way in other parts of France: he dwells on the cost and the necessity of wells, and the State help in the way of subventions for this purpose; he alludes with some not unjustifiable bitterness, detectable again at pp. 453–461, to the "lost opportunities" for good in the way of developing the resources of the Landes which the warlike folly of expenditure in Algeria has entailed; and finally, his allusions to the unhappy relations into which the Moors were successively brought with the Spaniards, with the French, and lastly with the Turks, are not without a singular interest and instructiveness. But M. Lavergne shall speak for himself and in his own language:—

"Un peu avant la révolution de 1789, au moment où tout s'éveillait à la fois, de grandes compagnies de défrichement se fondèrent, mais sans succès, pour avoir voulu aller trop vite; d'autres épais du même genre ont échoué plus récemment par la même cause. Il n'en a pas été de même des tentatives partielles faites en pleine connaissance de cause par les propriétaires du pays: plus d'une spéculation profitable s'est réalisée sans bruit sur des points isolés.

"Le chemin de fer de Bordeaux à Bayonne traverse maintenant les Landes dans toute leur longueur, et y apporte la puissance de l'industrie moderne. La valeur des terres a immédiatement doublé, triplé même, le long de la ligne, et tout le monde comprend que la solution du problème n'est plus qu'une question de temps. Rien n'était possible dans un pays sans chemins et sans eau: la compagnie du chemin de fer s'est engagée à ouvrir sur plusieurs points des routes munies de rails en bois, et si en même temps on parvient à créer de l'eau salubre, soit au moyen de puits ou de citernes,* soit au moyen de canaux dérivés des étangs, le plus difficile sera fait; le reste

* "Il suffit, pour avoir de l'eau potable, de creuser des puits de cinq à six mètres de profondeur, avec des parois imperméables, et d'y introduire une couche de gravier. Chacun de ces puits coûte 600 francs. Les Landes en possèdent déjà une cinquantaine, et on calcule qu'il suffirait de 100,000 francs pour en doter toutes les communes qui en manquent."

viendra de soi. La plus grande partie des terres incultes sera sans doute semée en pins, chênes et chênes-liéges, et pour accélérer cette transformation, une loi récemment rendue permet à l'État de boiser les terrains communaux jusqu'à concurrence de six millions de francs. Les autres branches de la culture ne doivent cependant pas être négligées, et il faut leur faire aussi leur part, car le danger des incendies, si grand pour des bois résineux sous un soleil ardent, ne permet pas de couvrir le sol d'une forêt immense et continue: une simple étincelle du chemin de fer suffirait pour mettre le feu de Bordeaux à Bayonne.

"Les Landes peuvent être aussi productives que quelque contrée que ce soit, mais elles conserveront toujours un caractère spécial. La singularité de cette nature sera un de ses charmes. Les régions inhabitées ne se prêtent que lentement à l'habitation de l'homme, et le régime pastoral, qui multiplie les animaux, et par eux les engrais, y sera longtemps, avec le régime forestier, le principal instrument du progrès. Quand on mesure par la pensée cette vaste solitude, qui s'étend jusqu'aux portes d'une de nos plus grandes villes, on s'étonne que la France ait pu songer à coloniser des pays lointains, au lieu de porter ses efforts sur elle-même. Si le dixième de ce qu'a coûté l'Algérie avait été dépensé dans les Landes, on aurait obtenu de meilleurs résultats, et l'on aurait épargné bien des flots d'un sang généreux; mais les stériles conquêtes de la guerre nous ont toujours beaucoup plus séduits que les créations fécondes de la paix. L'arrondissement de Mont de Marsan, bien qu'il renferme le chef-lieu du département, ne contient pas plus de 100,000 habitants sur 500,000 hectares, comme le Tel africain, et il s'y trouve plusieurs parties déjà très-peuplées et très-cultivées; dans la Lande proprement dite, il n'y a pas plus de 10 habitants par 100 hectares, et quels habitants! Cette terre, qui sera un jour populeuse et florissante, n'offre à l'œil qu'un spectacle de désolation: c'est le désert tel qu'on va le chercher au delà des mers, avec son triste silence, sa végétation chétive et ses horizons infinis.

"La tradition raconte que, quand les Mores furent chassés d'Espagne, à la fin du seizième siècle, ils demandèrent à s'établir dans les Landes, avec l'espérance de les fertiliser. Les préjugés politiques et religieux ne le permirent pas. Non moins civilisés à cette époque que beaucoup de peuples chrétiens, les Mores connaissaient d'excellents procédés de culture qui marquent encore leur passage dans les plus riches provinces de la Péninsule. Les Landes seraient probablement devenues pro-

ductives entre leurs mains, et ce qui leur restait de la barbarie musulmane aurait reculé devant les idées modernes de tolérance et d'égalité. S'ils ont tant dégénéré en Afrique où ils se sont réfugiés, c'est qu'ils y ont trouvé les Turcs, le plus destructeur de tous les peuples; cette civilisation a péri tout entière faute d'un asile où elle pût se développer. Mais le royaume qui devait bientôt révoquer l'édit de Nantes et expulser de son sein des Chrétiens et des Français, ne pouvait s'ouvrir à des enfants de l'Islam étrangers et persécutés, et ce qui a puissamment contribué à ruiner l'Espagne ne pouvait contribuer à enrichir la France."

Leaving now the subjects of the introduction of foreign trees, and that of the unintentional destruction of our own, and taking up the subject of disforesting generally, I have to say that the literature of it has in these latter days become all but colossal; and that the moral of it all is just the reverse of that of the capitulary of Charlemagne,* where it is ordained that wheresoever any good men and true are found to be available they may have forest land given them for clearing: *ubicunque invenient utiles ullos homines iis detur silva ad extirpandum.* Two hundred and fifty pages of the second edition of Mr. Marsh's excellent work, 'The Earth as modified by Man's Action,' are devoted to this subject alone; the bibliography extending over *nine* pages, prefixed to his work, is very largely made up of the titles of works bearing upon it; and I hold in my hand a small, but closely printed, German octavo, which has some 280 pages devoted to the purpose of specifying the names and giving a few lines as to the scope of such works. Its own title is 'Die Bedeutung und Wichtigkeit des Waldes, Ursachen und Folgen der Entwaldung, die Wiederbewaldung, mit Rücksicht auf Pflanzenphysiologie, Klimatologie, Meteorologie, Förststatistik, Förstgeographie und die Förstlichen Verhältnisse aller Länder, für Först- und Landwirthe, National-Oekonomen und alle Freunde des Waldes, aus der einschlagenden Literatur systematisch und kritisch nachgewiesen und bearbeitet von Friedrich Freiherrn v. Loffelholz-Colberg, königl. bayer. Oberförster.' Leipzig, 1872.

But in Herr v. Loffelholz-Colberg's list "aller Länder," there is no mention of India nor of its forest or other departments, nor of their annual reports, nor of the names of (1) Balfour, of Birdwood, (2) of Cleghorn, (3) of Dalzell, (4) of Danvers, (5) of Brandis, of J. L. Stewart, (6) of Colonel G. F. Pearson, or of

* Cap. secund. Anni 813, sive Capitul. xxi. ed. Stephan. Baluzius, 1677, tom. i. p. 510, De Villicis regiis quod facere debent.

Beddome, to each of whom, though unknown to me personally, I feel myself personally indebted. And extensive as is his bibliography, it admits of being supplemented by the specification not only of works which have appeared later, and in India, but of some of considerable importance which appeared earlier, and some of them in Europe of earlier date.*

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* For the Memoirs of the Indian authorities named above see:—(1) Revenue Department, No. 981, 1848; (2) Catalogue Bombay Products, 1862, and Journal Society of Arts, Feb. 7, 1879; (3) Sind Forest Reports, 1858–1860; (4) Journal Society of Arts, May 24, 1878; (5) Ocean Highways, Oct. 1872, and Systematic Works, p. 204; (6) Report on Forest Departments of India, 1872.

As regards other memoirs I find no mention of v. Baer's papers upon this very same question of the relation of woods to rainfall already referred to *supra*, in the 'Beiträge zur Kenntniss des Russischen Reiches,' iv. 1841, p. 190, xviii. p. 111, 1856. From the former of these two papers the following sentences may with some advantage be quoted, pp. 190–191:—"Noch viel weniger darf man glauben, dass nach dem Verhältnisse der Waldabnahme eines Landes auch die Wassermengen in seinen Flüssen abnehmen müsse. Es ist nicht unser Absicht den Einfluss ganz läugnen zu wollen; allein wir wollen nachdrücklich darauf aufmerksam machen, dass die Niederschläge aus der Luft nicht von den kleinern unter ihnen liegenden Localitäten abhangen, sondern von grossen ausgedehnten Verhältnissen, von vorherrschenden Luftzügen von der Quantität Feuchtigkeit welche diese Luftzüge mitbringen, von der Differenz zweier einander berührender Luftmassen, dass diese Niederschläge es sind, die unsern Flüssen Nahrung geben, dass in unsern Breiten sie in Form des Schnees mehrere Monate hindurch aufgespeichert werden und endlich, dass in einem so flachen Lande wie Russland die Feuchtigkeit welche in Form von Regen und Schnee niederfällt, aus sehr weiter Ferne kommen kann. Dass unsere Flüsse und besonders das Gebiet der obern Wolga in trockenen Sommern wenig Wasser haben, hat seinen Grund vorzüglich darin, dass hier kein Gebirge ist, an welchem Niederschläge das ganze Jahr hindurch nothwendig erfolgen und eben deshalb hat es ohne Zweifel von jeher einzelne Sommer gegeben, in denen das Wasser ungewöhnlich niedrig stand. Wir kennen Zeugnisse hierüber aus der Zeit Peters des Grossen, und ohne Zweifel wird man sie aus noch früherer Zeit finden wenn man darnach sucht."

And to supplement a second time the bibliography of Herr Loffelholz-Colberg, I will say that the following quotation from the well-known and accomplished writer of the sixteenth century, Bernard Palissy, may fairly take its place with the foregoing more strictly scientific opinion of von Baer. Mr. Marsh shall introduce it for us (*l. c.*, p. 303):—"In an imaginary dialogue in the 'Receipte Véritable,' the author, Palissy, having expressed his indignation at the folly of men in destroying the woods, his interlocutor defends the policy of felling them by citing the example of divers bishops, cardinals, priors, abbots, monkeries and chapters, who by cutting their woods have made three profits, the sale of the timber, the rent of the ground, and the 'good portion' they received of the grain grown by the peasants upon it. To this argument Palissy replies: 'I cannot enough detest this thing, and I call it not an error, but a curse and a calamity to all France: for when forests shall be cut, all arts shall cease, and they who practise them shall be driven out to eat grass with Nebuchadnezzar and the beasts of the field. I have divers times thought to set down in writing the arts which shall perish when there shall be no more wood; but when I had written down a great number, I did perceive that there could be no end of my writing, and having diligently considered, I found there was not any which could be followed without wood . . . . And truly I could well allege to thee a thousand reasons, but it is so cheap a philosophy, that the very chamber-wenches, if they do but think, may see that without wood it is not possible to exercise any manner of

I show you yet another work, an English Parliamentary Report, of date 1875, Feb. 1, respecting the Production and Consumption of Timber in Foreign Countries, from which a very large amount of most useful information can be procured for the very moderate charge of 11*d.*, one penny less than one shilling—a fact which would have rejoiced the heart of the late Mr. Joseph Hume. If in addition to this work we had rendered available to us the usufruct of the vast experience recorded in the Blue Books of the Indian Forestry and Sanitary Departments, in a volume of anything like the same size, I do not say of anything like the same price, the India Office would add considerably to the very large claims it has established upon the gratitude and acknowledgments both of men of science and men of action by the publication of those invaluable volumes.

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human art or cunning.'"—'Œuvres de Bernard Palissy,' Paris, 1844, p. 82, first published in 1563.

I may do well to neglect chronological order and mention the work by Dr. J. C. Brown, a Fellow of the Royal Geographical Society, which appeared in 1876 under the title, 'Reboisement in France; or Records of the Replanting of the Alps, the Cevennes, and the Pyrenees with Trees, Herbage, and Bush, with a view to arresting and preventing the destructive consequences and effects of Torrents.' Dr. Brown has besides this and other works on kindred or on the same subjects, given us a work on 'The Hydrology of South Africa, or Details of the former Hydrographic Condition of the Cape of Good Hope, and of Causes of its present Aridity.'

Professor Ernst Ebermayer's work, 'Die Physikalischen Einwirkungen des Waldes,' being the 'Resultate der förstlichen Versuchs-Stationen im Königreich Bayern,' Aschaffenburg, is of later date (1873) than the bibliographical *précis* of Loffelholz-Colberg, and would not therefore have been referred to by that writer as it ought to be by all subsequent writers on the same subject.

Professor Karl Koch's 'Vorlesungen über Dendrologie,' one-third part of which is devoted to the subject of the "Influence of Woods on the Health of Men, and on Climate," is similarly of later date (1875) than the last edition of Mr. Marsh's 'The Earth as modified by Man's Action.'

Latest in order of time, but by no means last in order of merit, I must place Professor Wellington Gray's 'Notes on Tree-Planting and the Water Supply of the Deccan,' Aug. 1877, contained in the excellent 13th Annual Report of the Sanitary Commissioner for Bombay, Dr. T. G. Hewlett. The influence on climate of cosmical as compared with local agencies; of mountain and monsoon, that is, as compared with man's plantations; and on the other, the influence of the brute population of India, the goats and the camels, as compared with the agency of the human inhabitants, who besides employing the two organic means for destruction just now mentioned, also "hack, cut, and burn," will be found instructively, though briefly, discussed in this essay. I take this opportunity of adding to this bibliography the names of three books with the contents of which I was not acquainted when I wrote as above. They are:—

'Wald, Klima, und Wasser, von Dr. von Liburnau,' 1878. This little octavo is one of the Munich series of Science Primers, being Bd. xxix. of 'Die Naturkräfte, eine Naturwissenschaftliche Volksbibliothek.'

'Die förstlichen Verhältnisse Frankreichs, von Dr. A. v. Seckendorff,' 1879.

'Der Wald im Nationalen Wirthschaftsleben, von Ph. Geyer,' 1879.

I do not propose, indeed I do not dare, to attempt to give a summary of the results of the very many volumes here alluded to, pleasant and even absorbing reading though many of them have proved themselves to be. I will not discuss the curious belief still prevalent in Spain, to the effect that trees breed birds, though somewhat similar articles of faith are not without adherents nearer home, merely observing, so that I may affront no one, that it would be truer to say that the destruction of trees leads to the banishment of birds, and thereby to the sexual, and in that sense spontaneous, generation of insects. Nor will I speculate as to whether the hatred of a tree, which you will be told in travelling in countries and districts at home and abroad (even in Sicily, see Fischer, *l. c.* p. 135), where the Celtic or other pristine ethnological element is still strong in the natives, is due to a hereditarily transmitted recollection of the days when, as the capitulary just quoted shows, man had to wage war against the forests, or a similarly transmitted recollection of the much more recent forest-laws and the feudal state of things contemporaneous with them. Neither, on the other hand, will I content myself with simply repeating Mr. Marsh's summing up of the matter in the short way which long words so often (literary critics notwithstanding) enable us to sum up the results of a long investigation, and saying with him that (p. 300, *l. c.*) the forest's "general effect is to equilibrate caloric influences and moderate extremes of temperature." But I will firstly, upon this occasion, repeat what I have often heard my late and much-lamented friend, Mr. Wm. Menzies, the author of the splendidly-illustrated book, 'Forest Trees and Woodland Scenery as described in Ancient and Modern Poets,' say, to the effect that England is after all as well wooded a country as probably any other civilised one in the world, adding that Sir John Lubbock has, as I think, either in some volume which he has contributed to science, or in some return which he has extracted from Parliament, established the same fact. And, remarking that if we couple with this fact the consideration that this favourable numerical representation of trees is not due to the existence of large forests, we find therein an illustration of the working of certain peculiarities of our social and political condition as compared with those of other countries, which I leave to your consideration; I pass on, secondly, to say a few words as to the influence which trees exercise in the way of modifying climate locally by means of their leaves. Clearly this comes fairly under the title of my lecture. Man can cut down "the goodly fir-trees" and other trees too, "Laubholzer"

as well as "Nadelholzer," of an entire country; he can burn them, and by his domesticated goats and cows and camels he can prevent their suckers and their seeds from replacing them by fresh plants. What consequences follow when the square area which a tree in full leaf represents is abolished? Firstly, whatever else may be disputed, there can be no doubt the loss of this square area means the loss of a very considerable area upon which dust and *particulate* matter can be caught and filtered out of the atmosphere. The more sticky the leaves, of course the more perfect the interception. And as modern investigations, such as those which Mr. John Simon, C.B., used to have carried on whilst in the Medical Department of the Privy Council Office, have taught all those who have ears to hear, even if not also eyes to see, that the germs of many or most infectious diseases are *particulate*,* we can understand how

* We have such accounts from Ravenna and Beyrout; from the East and the West Indies, and from Guiana. Lord Mark Kerr (see 'Report on Measures adopted for Sanitary Improvements in India for June 1871 to June 1872,' p. 14) did much planting in Delhi in 1864, and, on coming eight years later to take stock of the effects of his hygienic work, was able to persuade himself that the almost entire disappearance of the Delhi boil was due to this particular cause. But the Indian Government had to report in the succeeding year's volume of the same series, p. 17, that they had not received from the authorities they had consulted "reliable data to warrant any general conclusions being drawn as to the effect of trees and vegetation on these sores." Still they proposed "to institute a more particular inquiry into the matter, and to submit a Report on the investigations in due course." Upon this subject something may be found in Mr. Menzies' 'Forest Trees and Woodland Scenery,' 1875, p. 101, *q. v. ibique ab ipso auctore necnon a me citata.* Since the appearance of Mr. Menzies' work the literature relating to the *Eucalyptus globulus* as an agency for "purging the unwholesome air" has attained a great development. Especially to be recommended is a paper, 'The Eucalyptus near Rome,' by Dr. R. Angus Smith, F.R.S., published in the 'Proceedings' of the Literary and Philosophical Society of Manchester, vol. xv., No. 9, pp. 150–164, 1876, as also some papers in the 'Edinburgh Medical Journal,' February 1878, and May 1879, pp. 1052–1053, by Dr. Bell. And what is better even than good memoirs, good progress has been made in the way of actually planting this tree by no less conspicuous warriors than Garibaldi in the Roman marshes, and by Sir Garnet Wolseley in Cyprus. I have not, however, heard of any further development of the use of the *Helianthus annuus* as an anti-malarious agent, nor of the adoption of Mr. Menzies' recommendations of the employment of the horse-chestnut, the sycamore, or the balsam poplar and white poplar for the same purpose. To the references given *l. c.* may be added, as speaking in the same sense, Becquerel, 'Mém. Institut,' xxxv., 1866, p. 444, and Boudin, 'Géographie et Statistique Médicales,' vol. i. p. 229. Much has been written by the two last-named writers on the electrical action of trees; I will quote the following sentences from the latter of the two, *l. c.*, "Enfin le déboisement doit être considéré comme équivalent à la destruction d'un nombre de paratonnerres égal au nombre d'arbres qu'on abat; c'est la modification de l'état électrique de tout un pays; c'est l'accumulation d'un des éléments indispensables à la formation de la grêle dans une localité où d'abord cet élément se dissipait inévitablement par l'action silencieuse et incessante des arbres. Les observations viennent à l'appui de ces déductions théoriques."

it is that from so many quarters of the world we have more or less well-established histories of belts or curtains of trees protecting towns from malarious and anti-sanitary influences.

Secondly, though doubt may be raised (*e.g.* by M. J. Bellucci *cit.* 'Athenæum,' March 14, 1874, p. 360) as to the giving off by trees of ozone into the air, there can be no doubt as to another mechanical effect besides the one already dwelt upon in the way of breaking the force and the fall of raindrops, and thereby preventing, *pro tanto*, the over-rapid flowing away of such rain and the over-violent washing away of the soil. Simple as this action is, it is, when coupled with the action of the roots and their spongioles to which it gives a fairer chance of coming into play, one of the most important which a tree in leaf exercises. Finely divided rain sinks into the soil, whilst rain which falls in larger masses runs off and forms torrents. The roots making up an interlacing fibrillar mass by their multitudinous divisions, entangle and detain the moisture which comes to them in capillary columns; and from the loaded sponge which they thus come to represent, they dole or issue out in rations the supplies necessary for keeping springs and streams in constant and perennial volume.*

It is, I must say, a considerable marvel that upon a third function of that part of a tree which man can affect, either by his own hands or through the intermediation of his domestic animals with the greatest results in the way of mischief at the least cost of labour to himself, so much room for dispute and doubt should still be left open by the botanists. Upon this third function of the leaves, their power as evaporators, the most important perhaps of all their functions, both as regards the tree's own economy and as regards ours, it is little less than marvellous that a Professor of Botany should have to write thus in 1875. Professor Koch, however ('Vorlesungen über die Dendrologie,' 1875, p. 284), following Ebermayer, *l. c.*, p. 183, says: "The question of the evaporation of water through the

* It is of course possible to exaggerate the preventive power of arboriculture, as of other beneficial agencies. If a mountain is sufficiently high, and can be blown upon by sea breezes as yet undeprived of the full proportion of moisture which a warm latitude can give them, you will have *from time to time* destructive torrents rushing down their sides, however well wooded they may be. But what is an occasional occurrence only in a well wooded mountainous country, is a very common one in a district where the charcoal burner, the wood merchant, and the goat, have been allowed to have their wasteful will uncheeked. Homer's lines, Il. xi., 492–495, show that however striking the phenomenon he describes, it was nevertheless not so very common as the complaints with which so many of the Reports I have referred to prove it to be now in so many countries in Europe and elsewhere.

tissues of a plant is very like the question in medicine of the treatment of diseases. The more there is written about a disease, and the more we have so-called infallible remedies recommended for it one after the other, the less do we get of any real knowledge of it. There is scarcely a single point in the life of a plant on which so much, and indeed often so much that is intrinsically self-contradictory, can be specified as having been written, as this point of evaporation. Whilst Unger, and indeed certainly with right on his side, owns that a surface of (so much ?) water gives off by evaporation three times as much as (an equal surface of ?) a tree, Schleiden says that on the contrary the tree gives off three times as much as the open surface of water." *

It is true that Professor Koch goes on to say that nevertheless, as Sachs also has said, such observations and the results deduced from them have a scientific value. As it seems to me, they have not only a scientific value, as all observations which are reducible to weights and measures have, but that they have also a very distinctly appreciable practical value and applicability.

Anybody who will read the account given by my friend the Rev. Richard Abbay in 'Nature,' May 18, 1876, of the formation of a lake in a district in Australia, 150 miles from Sydney, and 2000′ above the level of the sea, subsequently to the destruction of the woodlands round about a particular area of depression, will be convinced that this occupation by water of what had been habitable land was not only posterior to, but caused by, the disforesting operations of the various agents specified, namely, squatters, grubs, cattle, sheep and opossums, not unaided by disease of the trees themselves. The surplus of water forming the lake corresponds to the enormous quantitative disproportion between the evaporating surface which it exposes when thus collected, and that which it would have exposed when dispersed through all the myriads of leaves which

* The German words, which I have not attempted to translate quite literally, are as follows:—

"Mit der Verdunstung des Wassers durch die Pflanze geht es, wie in der Medizin mit den Krankheiten. Je mehr über eine Krankheit geschrieben ist und je mehr nach und nach sogenannte untrügliche Mittel empfohlen wurden, um so weniger ist sie erkannt. Kaum möchte über einen Gegenstand im lebenden Pflanze so viel, und zwar oft einander widersprechendes, geschrieben worden sein, als über die Verdunstung. Während Unger, und zwar wohl mit Recht, behauptet, dass eine Wasserfläche drei Mal so viel verdunstet, als der Baum, sagt Schleiden, dass umgekehrt dieser drei Mal so viel verdunste als die offene Wasserfläche."

man and his allies had destroyed.* It is not, however, necessary to take such a long voyage as that to Sydney to get an unmistakeable illustration of the evaporating power of leaves. This power can be illustrated *e contrario* by observing the construction on the treeless Yorkshire or other English wolds of the perennial so-called "dewponds." It is not even necessary to travel as far as the nearest down or wold to make this observation, and fill in the necessary details as to extent of feeding ground to catch, and puddled ground to hold, the rainfall. A very simple experiment with plants no farther to fetch than cabbages, will show, as Professor Wellington Gray tells us (*l. c. supra*, p. 10), that 3000 square inches of their succulent leaves will give off as much as a pint of water per diem.

It may, however, be fairly objected that the rate of evaporation observable in an isolated mass of leaves, or in a single isolated tree, does not give us a measure of the rate at which the same process will go on in a wood when the exposed and evaporating surface is relatively so much smaller. And this difficulty, which lies in the geometrical nature of the case, may account for the great discrepancies in the estimates which various writers have given of the amount of watery vapour given off by masses of wood.†

It must, however, be allowed that the cases in which the cutting down of trees, and the consequent putting into abeyance

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* See also Ebermayer, *l. c.* pp. 184, 185.

† Professor Pfaff, for example (*cit.* Ebermayer, *l. c.*, p. 186), gives us 120 kilogrammes as the entire amount evaporated by an oak with 700,000 leaves, each of a square surface of 2325 mill. during the period from May 18 to October 24.

Vaillant (*cit. ibid.*) gives the amount of watery vapour given off by an oak of 21 mètres height and 2·63 mètres girth at a height of 1 mètre above the ground, as 2000 kilogrammes on a fine day.

Hartig (*cit. ibid.*), the author of a 'Lehrbuch für Forster,' Stuttgart, 1861, calculates that a German morgen (= 2·3895 acres), carrying a thousand trees of nine different kinds of conifers and broad-leaved trees of twenty years' planting, exhales daily during the period of vegetation at 3000 pounds weight of water.

Professor Prestwich, in his 'Water-bearing Strata,' 1851, p. 118, gives us as an estimate for the amount of watery vapour given off by the leaves of "a tree of average size" two and a half gallons per diem.

Mr. Lawes (*cit. in loc.*), from 'Journal of Horticultural Society,' vol. v. pt. i., 1850, gives us as a foundation for an estimate of the relations between the amount of water taken in by vegetable organisms, with the matters it held in solution, and the solid residue thence extracted and retained by the plants for its uses or for ours, a statement to the effect that three plants of wheat or barley gave off 1½ gallon, 250 grains of water for every grain of solid residue in the adult plant.

Hellriegel, on the other hand (*cit.* Ebermayer, *l. c.* p. 187), gives us as his estimate that for the production of 1 lb. of dry barleycorns, 700 lbs. of water, inclusive of the water evaporated from the soil, are all that is necessary, and that other cerealia have their demands limited within somewhat similar proportions. *Intervalla vides humanè commoda.*

of the functions of their leaves, have been followed by the drying up of springs, are much more numerous, even if they are not better established, than those in which the reverse effect has been recorded, as by Mr. Abbay. The explanation of this apparently self-antagonising or capricious operation of the same primary cause is not far to seek. When a tree is cut down, the area once protected by its leaves is exposed to the uncounteracted action of the summer sun, and rainfall may run off it when thus hardened, just as it runs off an imperfectly thawed surface in the spring, or may sink away into chinks and fissures which that exposure may, and very often does, produce, and in either case such rainfall is lost to the summer-dried fountain. If the water thus thrown upon the surface, thus modified, finds its way into a basin properly proportioned as to cubical, as to square area, and as to water-holding power, we may have a lake formed, as in the case related above by Mr. Abbay. It is, of course, more usual to find one or other, or two or all, of these favourable conditions wanting, and in the more numerous class of cases we find that the diminution of wood and the diminution of water go hand in hand. I would go further than this, and aver that the diminution of wood and the diminution of water in the shape of ice may not only also go hand in hand, but may also be connected as cause and effect. M. Viollet-le-Duc, in his delightful work on 'Mont Blanc,' 1877 (translated by B. Bucknall, pp. 341, 353), tells us that "although the glaciers have been tending to diminish for the last forty years in a somewhat rapid ratio, which would seem to indicate an elevation of the mean temperature, the forests are quitting the heights where they still lingered, to take a lower position. Is there any connection between these two results? We shall not endeavour to solve the problem." It is a little presumptuous to address one's self to it after this deterrent warning. Still M. Viollet-le-Duc has (*l. c.* pp. 339, 377) shown us that the destruction of the forests is abundantly explained irrespectively of any inorganic agency by the mischievous action of man working as a goatherd and a woodcutter. His descriptions of these operations are couched in language of real pathos and eloquence, but scientifically it shows us that we need not look for any other cause for the disappearance or shrinking of the limits of the forests. The spruces and the larches, for such are the trees, being thus destroyed by the "essentially destructive power" of man, how can their destruction be shown to entail the diminution of the glacier? I think the loss of these trees as evaporating agencies may be taken as

a *vera ac sufficiens causa* for the diminution. A great deal of great interest has been written * upon the difference in the amount of watery vapour given off by various trees and by the cerealia, which last, and amongst which last, as might be expected from their deep roots and the amount of their *Stoffwechsel*, wheat-plants stand quantitatively pre-eminent. But for our present purpose it is sufficient to point out that the rays which strike on the mass of a glacier are, to say nothing of the other conditions of disadvantage which such a mass opposes to them, enormously *outnumbered* by the rays which strike on the needle-shaped leaves of an adjacent wood of ordinary acreage, made up of such trees as the spruce or the larch; and the vapour which is thus set free into the entire circumambient atmosphere alike of glacier and of wood, acts most potently in several ways in the direction of saving the glacier from wasting.

On the other hand, great as the influence of the evaporating power of trees and forests may be shown to be in some directions, it is possible enough to overrate it as regards such more than localised matters as the increase of the rainfall. "It is," says Dr. Brandis ('Ocean Highways,' Oct. 1872, p. 204), "a widely spread notion, entertained by many writers who are competent to judge, that forests increase the rainfall, and that the denudation of a country in a warm climate diminishes its moisture. Much of what is known regarding the history and the present state of the countries round the Mediterranean seems to support this theory, but it has not yet been established by conclusive evidence." The important point seems to be that in *mountains* this influence may count for something considerable, whilst in the plains, howsoever well wooded, trees can act only as do other good radiators in the way of precipitating not wind-borne moving vapour, but simply dew.

Mr. N. A. Dalzell, in the Report on the Sind Forest for 1859–1860, observes (par. 31): "Although it would be too hardy an assertion to say that the existence of forests in Sind causes any increase in the fall of rain, they certainly do so on the summits and tops of mountains;" and par. 35: "In enumerating the benefits derived from forests, I make here no use of the fact that forests attract rain-clouds, because I do not think it applicable to plains, and because it is not yet clear that causes are not mistaken for effects, that is, whether it is the rain produces forests, or forests which produce rain; and certainly no inhabitant of Sind would consider it legitimate to decide that

* See Vogel, Pfaff, and Hartig. *citt.* Ebermayer, *l. c.*, p. 185.

because a country is covered with wood, therefore it is wet." It is satisfactory to be able to add that the result of Professor Ebermayer's prolonged observations in Bavaria has brought him to the same conclusions as those of Dr. Dalzell, carried on in the very alien surroundings of Sind. Dr. Ebermayer's words on this subject, used in summing up the results of his researches, are (*l. c.*, p. 202): "Auf Grund unserer Untersuchungen, glauben wir daher besuchtigt zu sein annehmen zu dürfen, dass in Ebenen von gleichern allgemeinen Charakter der Einfluss des Waldes auf die Regenmenge jedenfalls sehr gering ist, und dass er auch auf die procentische Regenvertheilung keine Einwirkung hat. Mit der Erhebung über die Meeresoberfläche nimmt die Bedeutung des Waldes bezüglich seines Einflusses auf die Regenmenge zu, er hat desshalb im Gebirge einen grosseren Werth als im Ebenen. Im Sommerhalbjahr ist die Einwirkung des Waldes auf die Regenmenge viel grosser als im Winterhalbjahr."

Whatever the physical principles involved are, anybody may find beautiful illustrations of them, who will observe in a mountainous district how—

> "The swimming vapour slopes athwart the glen,
> Puts forth an arm and creeps from pine to pine,
> And loiters slowly drawn," *

or how

> "The light cloud smoulders on the summer crag," †

recollecting that the phrase "Rauchen der Walder" is used for the similar phenomenon when produced by trees, or who will finally in a lowland or other country stand and study the frost as it hangs itself on to such a tree as the birch often long before it has begun to whiten the ground around it.

[Since writing as above, the 'Observations Météorologiques faites de 1877–1878,' by M. Fautrat, published by the French "Ministère de l'Agriculture et du Commerce: Administration des Forêts," 1878, have come into my hands. This author, with the results of M. Mathieu's eleven years' observations at Nancy (for which his 'Météorologie Comparée Agricole et Forestière,' published under the same auspices, February 1878) before him, as also the results of four years' observations in the Forest of Halatte, and of three years in the pine-woods of Ermenonville, has come to the following conclusions.

i. That when it rains more rain falls over a wooded than over a non-wooded area, and that whilst trees of all kinds

* Tennyson, 'Œnone.' † Tennyson, 'Edwin Morris.'

possess the powers of condensing vapour, broad-leaved trees produce less effect than is produced by the narrow-leaved Coniferæ (pp. 14 and 16).

ii. That as regards the hygrometric condition of the air, the air over a wooded area contains more watery vapour (p. 18) than an unwooded area, but that the coniferæ have more watery vapour in their circumambient atmosphere than the broad-leaved trees. M. Fautrat expresses, or rather expands, this fact in the following words:—"If the vapour dissolved in the air was visible as are mists, we should see the forests surrounded with a vast screen of moisture, and around the Coniferæ this envelope would be more marked than over the broad-leaved trees. What is the source of this vapour? Does it come from the soil; is it the result of evaporation from the leaves, or is it due in the Coniferæ to the action of the thousands of points which the whorls of their leaves develop every year? *This is a complex question which the present data of physical science do not enable us to answer.* One thing one can say, and that is that the transpiration of the leaves cannot by itself produce this phenomenon. For, as a matter of fact, the transpiration in Coniferæ is less active than it is in broad-leaved trees. This fact has been made clear by M. Grandeau in his 'Essais historiques et critiques sur la Théorie de la Nutrition.' (M. Fautrat might have added, "as also by Hales *cit.* Boussingault, 'Ann. Chim. et Phys.' sér. v. tom. xiii. 1878, p. 314, and Sachs, 'Handbuch Exp. Physiologie Pflanzen,' 1865, p. 225.") It then follows that if the vapour of water dissolved in such great abundance in the atmosphere enveloping the pines was the result of the evaporation of the trees, this phenomenon ought to be much more striking over the mass made up by the broad-leaved trees than in that made up by the Coniferæ, whilst observation shows that exactly the contrary is the actual fact. We must therefore ascribe to the soil and *to other unknown causes* this remarkable property which pines have of attracting watery vapour." If it had appeared from M. Fautrat's tables that this excess of watery vapour was more marked in rainy than in dry times, it would have been easy to explain the fact by figuring to ourselves the all but infinite area which the fine films of water clothing every needle-shaped leaf of a coniferous tree would make up and offer for evaporation. For the leaves of our common Coniferæ wet readily; and it is owing to this property I apprehend that they intercept as much as one-half the rain which falls upon them before it reaches the ground, whilst broad-leaved trees intercept but

one-third. But, as it appears, the Coniferæ possess the hygrometric advantage independently of the rainfall. And I have to say that the phenomenon in question needing, as it thus confessedly does, some additional explanation besides and beyond that which our usually accepted views furnish, appears to me to become more intelligible by reference to the theory as to "The Cause of Rain and its Allied Phenomena," which was put before the world in 1839, and subsequently published in a separate volume twenty years later by Mr. G. A. Rowell. This theory may I think be stated as follows, the author of it having slightly modified it in 1872, and restated it in a 'Brief Essay on Meteorological Phenomena,' published in 1875. He supposes that the molecules of watery vapour are completely enveloped in a coating of electricity to which they owe their buoyancy. This coating and this buoyancy he supposes to increase and decrease in ratio with the temperature of these molecules. Efficient conduction therefore of electricity will suffice on this theory to precipitate watery vapour either as rain, or as dew, or as mist. And I apprehend that Mr. Rowell would, in accordance with his own theory, look upon a fir-tree when shrouded, as M. Fautrat has described it, with a differentially thick envelope of vapour, as having thus clothed itself by virtue of the attractive effect of its myriad points. For electricity tending constantly to an equal distribution, so fast as the surcharge of electricity on the particles of vapour nearest the trees was carried away, so fast would the balance be redressed by supply from the particles more distally placed. And thus in accordance with this theory, particles of watery vapour would be constantly setting in the direction of the conducting and attracting leaves and twigs. Becquerel's view, already quoted, according to which the plague of hail which has so often * been observed to follow upon the destruction of the woods of a country, is to be ascribed to the loss of the lightning-conductors which the cut-down trees represented while standing, and to the absence consequently of the incessant

* See a really pathetic account of this given as having been produced during his seven years' absence from Thüringen by Fischer at p. 164 of his charming 'Beiträge zur physischen Geographie der Mittelmeerlander,' 1877. Rain and hail-storms had become frequent, and the fishing brook had disappeared together with the wood of his boyhood. He adds:—

"Ich will gewiss damit nicht sagen, dass in jenen Gegend jetzt auch nur ein Tröffchen Regen weniger falle als früher, obwol auch das ortlich möglich, ja wahrscheinlich ist, aber der Vertheiler und Bewahrer der Feuchtigkeit fehlt und so können locale Ursachen zeitweilig Wirkung haben, die in Sud-Europa allgemeinen kosmischen, aber durch örtliche verstärkten zu zuschreiben est. Ich wurde recht lebhaft an Sicilien erinnert, aus dem ich eben heimkehrte."

though insensible dissipating agency of the trees, appear to me to show that he at least would have allowed that Mr. Rowell's theory contains some, at least, of the elements of the true and complete theory of rain. It is not for me to meddle with memoirs in which neither living animal nor living vegetable organisms are concerned, otherwise I might have referred to Lord Rayleigh's paper in 'The Proceedings of the Royal Society,' March 13th, 1879, pp. 406, 409. But as regards the views they brought forward, and to a considerable extent as regards the whole question, I scarcely feel myself to be in a position to give any decided opinion.

That trees, like other beneficent agencies, do not fail to benefit themselves whilst thus benefiting the world at large, may be well gathered from the following passage from Professor Grandeau's work now in course of publication, "Chimie et Physiologie appliquées à l'Agriculture et à la Sylviculture, 1879, Pt. I. la nutrition de la plante." In summing up at p. 340 the results of his experiments, and after saying that the simplest and at the same time the best way of isolating a plant for purposes of experiment from the action of electricity, is to place it either under a metallic cage with large meshes, *or in the perimeter of a tree;* M. Grandeau proceeds as follows:

"2° Les végétaux et en particulier les arbres, soutirent à leur profit l'électricité atmosphérique et isolent aussi complètement qu'une cage métallique la plante qu'ils dominent.

"3° L'isolation produite par un arbre élevé peut s'étendre notablement au delà du périmètre foliacé de l'arbre.

"4° Une plante soustraite à l'influence de l'électricité atmosphérique subit, dans son évolution et dans son développement, un retard et une diminution très notables. Dans mes expériences, les quantités de substance vivante produite par les végétaux isolés ont été inférieures de 30 à 50 p. 100 à la production à l'air libre. La transformation du protoplasme chlorphyllien en glucose, en amidon, etc., paraît être tout particulièrement influencée par l'électricité atmosphérique.

"5° La floraison et la fructification subissent des modifications non moins grandes; sous cage isolante et sous les arbres, le nombre des fleurs, des fruits et le poids des graines ont été inférieurs de 40 à 50 p. 100. L'arrêt dans l'assimilation semble porter tout d'abord sur l'élaboration des principes hydrocarbonés.

"6° Le taux centésimal de substance sèche et le taux des cendres sont plus élevés en l'absence de l'électricité, les végétaux qui croissent hors cage s'étant constamment montrés

plus riche en eau et plus pauvres en matières minérales que la plante de même espèce sous cage isolante."

M. Celi's adaptation of one of Sir W. Thomson's apparatuses as an "Appareil pour expérimenter l'action de l'électricité sur les plantes vivantes," *cit.* and figured by M. Grandeau *in loco* from 'Annales de Chimie et de Physique,' ser. v. tom. xv., October 1878, is well worthy of inspection in this connection.]

The next part of my Lecture will be devoted to showing by the aid of three maps and one statistical table, how greatly man has modified the external aspect of the world he lives in by the introduction into the several parts of it of cultivated plants and domestic animals, previously, of course, unknown even in the wild state, to such areas of its surface. The maps by their colours show the areas on which the parent stocks of the most valuable and now most widely spread of these acquisitions have, with more or less of approach to demonstration, been shown to be indigenous. The short table of statistics tells you in its second line that one-half of all of them came from one single "quarter" of the globe, or in the language of modern zoogeographers from one single zoological "region." The table and the maps taken together show us how largely some quarters of the globe have been benefited by borrowing from others, or in the language of my subject, how largely they have been modified by man's interference.

The first of these maps is very closely similar to the one which shows on Mercator's projection the now more or less generally accepted zoogeographical regions of the earth's surface, the Palæarctic, to wit, the Ethiopian, the Oriental, the Australian, and the two regions of the New World, the Nearctic and the Neotropical; as given by Mr. Sclater, and in Wallace's great work on Geographical Distribution.

The second of these maps is an enlargement of that given by Professor Huxley in the 'Journal of the Ethnological Society of London,' June 7th, 1870, to illustrate and embody his views on the distribution of the principal modifications of mankind. This map, besides other useful purposes, serves specially that of limiting off, by a special colouration, a particular portion of the vast Palæarctic region which is specially important to the subject in hand, as it was either actually upon it, or upon regions closely adjacent to it within that region, that the parent stocks of the moiety of our cultivated plants and domesticated animals may either be found still living or may reasonably be supposed to have existed formerly. The particular subdivision of the Palæarctic Region

has been coloured in a particular way by Professor Huxley, so as to indicate that upon it his "Melanochroic" or dark-white variety of our species was living not in perfect purity of stock, but more or less peacefully intermingled with the Mongoloid and with his "Xanthochroic" or fair-white varieties. The area thus occupied occupies itself on the map a district something of the shape of a tuning-fork, the two arms of which would form the northern and southern boundaries of the Mediterranean eastward from the longitudes of Albania and Tripoli; and would be carried by a broad base extending from the Caucasus over Syria and a part of north-west Arabia to the Red Sea, whilst its stem would cover Kurdistan, Khorassan, and North Persia, and end by bifurcating at a spot near Peshawur. The importance of this area is illustrated by the fact that a region very closely corresponding, if not quite coincident with it, is marked out upon quite different principles in the next map. A coincidence of much less intricacy, and therefore of much less cogency, though still not without a certain curious significance, is furnished to us by the fact that a certain island of blue colour, placed by Professor Huxley in the "Dark Continent" of Africa to indicate the presence in Upper Egypt, Nubia, and Abyssinia, of some traces of the Australioid type, corresponds with the area in that continent whence most or all of her few gifts of valuable cultivated plants and valuable domesticated animals have come to us, viz., the cotton plant; and, very probably, the date-palm; the ass, from the native stock *Asinus tæniopus;* and the cat, from the native stock *Felis maniculata.*

Of the two arms, into which the eastward end of this area bifurcates, the upper or northward one, would correspond with the Kuenlun range; and the southward with the Himalayas; Ladak, and part of the table-land of Thibet, lying between them. It is in the Kuenlun range that Jade mines are found.

The third map, being one of Johnston's charts of the World on blank Mercator's Projection, has been coloured so as to illustrate the following facts in the distribution of certain plants and certain minerals connected with the ancient development and subsequent progress of human civilisation. One region is coloured as it is in the 'Plantegeographisk Atlas,' tav. ii., of Professor Schouw, Copenhagen, 1824, so as to show the distribution of the *Vitis vitifera* over the countries forming the northern and southern shores of the Mediterranean and Black Seas, over Asia Minor, Palestine, and Mesopotamia, over the lowlands both of Astrakhan and Turan, and along the southern slopes of the Himalayas, so as to end at the eastern extremity of that chain In nearly the same latitude as that eastern extremity, and

about in the same longitudinal line as the long axis of the Peninsula of Malacca, a spot of another colour marks the situation of the amber mines of Burmah,* while four spots of yet a third colour in British Burmah, Banca,† Celebes, and Khorassan,‡ respectively indicate localities in which copper and tin are still found in such proximity to each other and in such accessible abundance as to suggest that it is not improbable that in some one of those districts prehistoric man may have come upon the invention of bronze. A fourth colour marks the position of the Kuenlun Jade mines,§ whence, in still earlier than bronze times, stone weapons may with great probability be supposed to have been procured by man before he migrated into the jadeless regions westward.

The New World was coloured as it is in Schouw's tav. viii. *l. c.*, to show the area of distribution of the Cactaceæ, a region comprehending South America north of the Tropic of Capricorn, the Isthmus of Panama, the Peninsula of California up to 30° N. lat., the West Indian Archipelago, the northern shores of the Gulf of Mexico, and the strip of gulfstream-washed North American coast between the Alleghanies and the Atlantic up to about 40° N. lat. From this area more than 25 per cent. of all our cultivated plants have been procured, as the annexed table shows; and, of course, since the time of Columbus.

This table (based, so far as it deals with the vegetable kingdom, mainly upon De Candolle's 'Géographie Botanique,' pp. 986–987) gives approximatively the proportions in which the several "regions" of the globe established by that phytogeographer and by several zoogeographers, have contributed to make up the lists of such cultivated plants and domesticated animals respectively as are of considerable, even if not always of cosmopolitan, importance.

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* For the Amber mines of Burmah see Balfour's 'Indian Cyclopædia,' *s. v.*, 1871; and Keith Johnston's 'Royal Atlas,' map 28, *in loco* lat. 26° 20′.

† For the existence of tin together with copper in Burmah see Mortillet, 'Révne d'Anthropologie,' i. 1875, p. 653.

‡ For the similar collocation of the two metals which when combined make bronze in Khorassan and elsewhere in Central Asia south of the Caspian, see v. Baer, 'Archiv für Anthropologie,' ix. 4, p. 262, 1877. We know from the same irrefragable authority, Bulletin Acad. Sci. St. Pétersbourg, tom. xvii. p. 417–431, 1859, and tom. i., 1860, pp. 35–37, that the date-palm is still represented a little to the north of these deposits of tin and copper, at Sari, in the as yet Persian province of Mazanderan on the south shore of the Caspian. This tree is supposed to have been carried thither, as to so many other places, by the Arabs during their career of conquest, which contrasts to such advantage and in so many ways with that of other Mussulman conquerors.

§ For an account of the Jade mines in the Kuenlun Range see Cayley, 'Macmillan's Magazine,' October 1871; and for Jade generally, Rudler 'Popular Science Review,' October 1879.

Of (approximatively) 160 *Cultivated Plants.*		*Of (approximatively)* 21 *Domestic Mammals.*
	Per cent.	Per cent.
The Palæarctic species are ..	50	50 are Palæarctic.
„ Oriental „	25	14 „ Oriental.
„ African „	25	14 „ African.
„ Nearctic „	2·5	0 „ Nearctic.
„ Neotropical „	25	14 „ Neotropical.
„ Australian „	0	0 „ Australian.

Of some of the great facts which these maps and this table put before you, half diagrammatically, the anthropologists, zoologists, and geographers* of the last quarter of the last

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* Pallas, Betrachtungen über die Beschaffenheit der Gebirge: an Address delivered Jan. 23, 1777. Zimmermann, 'Geographische Geschichte.' Bd. i. p. 114, 1778—Bd. iii. p. 250, 1783. Link, Die Urwelt und das Alterthum, i. p. 243 *seqq.* 1821.

There is perhaps no need for me to apologise for quoting the exact words of Pallas's Discourse, the less so as, though it appeared in two forms, one German the other French, within a year of its being delivered, it is not, I think, a very common book. The issue which I quote from is that of 1778, the year in which his *Novæ Species Glirium* appeared, six years later than the year in which the second volume of his *Spicilegia* with its wonderful *Fasciculus* XI. was published.

The difficulty in reading Pallas is to understand how his writings can bear the date they do. But he shall speak for himself:—"In den mittägigen Thalern dieses alten Landes muss man das erste Vaterland des menschlichen Geschlechts und des weissen Menschen suchen, die von dort in ganzen Nationen die glücklichen Gegenden von China, Persien und besonders Indien bevölkert haben, dessen Einwohner nach dem allgemeinen Geständniss unter allen Nationen die ersten gesitteten waren, und wo man vielleicht die Stammwurzeln der ersten Sprachen in Asia und Europa suchen muss. Selbst Tybet, eine der höchsten Gegenden Asiens dessen Einwohner, ihrem Vorgeben nach, von einer Ort Affen welche dieses Land zuerst bewohnten, abstammen (mit welche sie auch ohnedem einige Aehnlichkeit haben) Tybet hat die Verfeinerung seiner Sitten jenem Lehrern zu danken, die aus Indien dahin kamen." Pallas adds as a note to this passage, "Ich kann nicht umhin, hier zu bemerken, dass alle, so wohl in den nordischen, als in den mittägigen Ländern von dem Menschen zu Hausthieren gezämte Gattungen, in den gemassigten Erdstrichen des mittlern Asiens ursprünglich wild gefunden waren, das einige Kameel ausgenommen dessen beyden Abartungen nur in Africa gut fortkommen." Pallas then proceeds to instance the wild ox, the buffalo, the wild sheep, the Bezoar goat and the Ibex, from a crossing of which he supposes our common domestic goat to have arisen; the wild boar and, as I believe, incorrectly, the wild cat (*Felis catus*), as being the parent stocks of their domesticated namesakes, and having their original homes in the mountains which occupy Central Asia and a part of Europe. He adds, "Das zweybuckelige Kameel ist in den grossen Wüsten zwischen Tybet und China noch wild vorhanden." Prejevalsky's "From Kulja across the Tian-Shan to Lobnor" will be familiar in its English translation to most of us; his account of the wild camel is not more interesting as compared with this remark of Pallas' than in his account, p. 38, of the devouring of apples and apricots on the northern slopes of the Tian-Shan by wild boars, goats and deer, when compared with Tournefort's words ('Voyage du Levant,' Amsterdam, 1718, 4, t. 2, p. 129, cited by the Botanist Link, *l. c.*, p. 234) describing a country which he visited and found to be "Ein Land erfüllt mit natürlichen Weinbergen und Obstgärten wo Nussbäume, Aprikosenbäume, Pfirsichbäume, Birnbäume und Apfelbäume von selbst wachsen. Er setzt hinzu, man kann nicht zweifeln, dass hier einer von den Theilen Georgiens ist, wo, nach Strabo, alle Arten von Früchten in Ueberfluss sind, welche die Erde ohne Cultur hervorbringt."

century and the first third of this had possessed themselves; and following, at whatever distance, the great Pallas, they insist upon the strength of the claims of that portion of Central Asia whence issue the great rivers Ganges and Indus, Tigris and Euphrates, and which they speak of as "den grossen Buckel Asiens," to be considered as the primitive home of man, mainly as it was, according to them, the original home of *all* our domestic animals and so many of our cultivated food-plants.

These writers and discoverers slightly overstated their case when they said that *all* our domestic animals could be referred to parent stocks indigenous to that region, though, as will be shortly shown hereafter, it would have been little beyond the truth if, instead of saying all the domestic animals absolutely, they had said all the domestic animals *which are absolutely indispensable to modern man's comfort and progress.* But their case for their particular thesis would have been greatly strengthened if they had known that jade in the form of stone implements had accompanied man together with the goat into Western Europe, and was found no nearer to the Swiss Lake Dwellings, than are the Kuenlun mines pointed out on my map; if they had known that copper and tin could have been smelted together into bronze so readily either in Khorassan or in Burmah; if, to put however injudiciously, my weakest point last, they had also known that amber—such a frequent accompaniment of prehistoric man—also lay within easy reach of his curious hands in this latter country. But prehistoric archæology has till lately made but little advance since the time of Lucretius. Decandolle ('Hist. des Sciences et des Savants,' p. 263, 1873), indeed, classes it as a discovery as new and as great as five others of the twenty or thirty years previous to 1873, viz., spectrum analysis, convertibility of force, the greater extent of glaciers in geological times, natural selection, and the alternation of (animal) generations; and the writers referred to knew not, and could not have known, the whole strength of their position. As regards my present purpose it is, in these but little later days, superfluous to point out how the discovery of mines whence pre-historic man must, or at least might, have furnished himself with his weapons, implements, and ornaments, actually upon or along the same mountain ranges, spurs, and valleys in which he must, or at least might, have found in a wild state the animals which he has now around him as neces-

Georgia lies some distance away from Lobnor, but both alike lie well within the great mountain system with its outliers which is called "Asiens Buckel" by the other writers, as also I apprehend within the modern "Steppengebiet" of Griesbach.

sary and universal elements in his own social life, bears upon the extent, as measured by latitude and longitude as well as by other gauges, to which the world has been modified by his migrations and importations.

Let me now enumerate the twenty domesticated mammals which we possess, and which for practical purposes may be taken as making up a tale of about twenty or twenty-one; let me specify which amongst them belong, as regards their origin, to the Palæarctic region, and to the restricted portion of it already dwelt upon and defined, as the maps show you; and thirdly, leaving considerations of locality and of number, let me contrast the value of the nine, ten, or eleven mammals which man domesticated in that district with that of the others acquired from* or contributed by all the other regions of the globe taken together.

Our twenty-one chief domesticated mammals may be enumerated in something like order of merit and necessity to us as follows: the dog, the cow, the sheep, the pig, the horse, the cat, the goat, the ass, the camel, the dromedary, the buffalo, the alpaca, the vicugna, the reindeer, the zebu, the banteng, the yak, the ferret, the rabbit, the mongoose, and the guinea-pig, omitting some few species the importance of which as being locally limited to very small areas, and as consisting of individuals numerically few, is too small to make it necessary to notice them. Representatives of more than one-half of this list can be fairly claimed by the Palæarctic centre of creation as owing their parentage to stocks native to its soil; this half consisting of the dog, the cow, the sheep, the pig, the horse, the goat, the camel, the dromedary, the reindeer, the ferret, and the rabbit. I have said "representatives" of one-half of this list because it is more than probable that some of our breeds of domestic dogs and of pigs may have been reclaimed from wild parent-stocks in other regions of the world. There can, however, be no reasonable doubt that the great majority of the domestic breeds known till comparatively recent times in Europe, of each of those two animals, the dog and the pig, were drawn from parent-stocks living in the Palæarctic Region, and this is all that is necessary for my present argument.

* It is a curious point in mythology that, so far as my memory serves me, no god nor demigod should have the credit assigned him of having domesticated any animal except the horse. Of course this fact, if fact it be, shows two things with more or less probability; firstly, namely—that these acquisitions were made in very far-off times, not merely in "the ages before morality," but in those much earlier ones, "the ages before history;" and secondly, that the acquisition of the horse was made in later days than the domestication of the other animals in question.

As regards the ox, the sheep, the horse, and the goat, I cannot think that with our present knowledge of zoogeography there can be any question that their parent-stocks were Palæarctic animals; and I am further prepared to express my belief that further investigation will render it highly probable that it was in that particular though very extensive part of the Palæarctic Region spoken of vaguely as "Asiens Buckel," or "Hoch Asien," and comprehending portions of all the great mountain ranges from the Caucasus proper to the northern side of the Hindoo Koosh, and from the Taurus to the Altai Mountains, that these several parent-stocks were brought under the influence of domestication. Wild animals are still to be found in some one or other or in several spots within that area from which we have no *à priori* reason for doubting that man might in the course of ages have educed the three last-named of the four domestic animals, the ox, the sheep, the horse, and the goat; and that a wild ox existed in the regions in which the Old Testament writers lived, not only their writings, but the Assyrian sculptures, and not only the Assyrian sculptures, but geological remains testify. The case, however, for the ox, having been first domesticated in Central Asia, is the weakest of the four, and it may be well to take it first. The Rev. Wm. Houghton has in his memoir on the domestic mammalia of the Assyrian sculptures ('Trans. Soc. Bibl. Archæology,' v. i., st. i., p. 2, 1876, and *ibid.* 1877, p. 54) given us a very spirited drawing from one of the Assyrian sculptures representing the hunting and the killing of the wild ox. What is of special value in this sculpture is for our purpose the presence between the shoulder-blades of a hump, which is present in so many other of the larger Ruminantia, but which, as Mr. Houghton remarks, reminds us of the Indian zebu, and of the fact that there are no specific differences between these two oxen underlying their soft parts. There can be no doubt that the figure is intended to represent a wild animal. The Accadians, who were in the habit of giving names to animals which referred to the countries whence they obtained them, gave names to the ox, which Professor Sayce thinks must refer to the country between the Euphrates and Syria and to Phœnicia. The bulls of Bashan, and possibly of the Taurus range, may be rightly recalled to our memories by these names. The European names for the ox, on the other hand, are said by M. Joly (*cit.* Isidore St. Hilaire, 'Hist. Nat. Gen.' iii. p. 89) to have an Asiatic origin, and M. A. Pictet ('Des Origines Indo-Européennes,' pp. 330–343) has declared his views to the same effect. This, however, is only what would have been expected in the European languages of the Aryan division.

What is of importance as regards the domestication of the ox is to note that though such languages as the Finnic may use loan words taken from Aryan tongues to express the general idea of Ox (= Bovine animal), they frequently have true Turanian vocables to denote such particularities as we have in view when we speak of heifers, calves, cows, bulls, and the "ox," *sensu strictiori*, confirming in the last matter the statement of Strabo (vii. 4, 8) that castration was learnt from the eastern Europeans and Sarmatians. There is in fact a good deal of evidence for a view which should hold either that the Turanian races domesticated the wild ox, or rather the wild calf, independently; or that the human species did this great work before the differentiation into Aryan-speaking and Turanian-speaking men was carried out. That the Scythian breed of cattle should have been hornless in the time of Herodotus (iv. 29) appears to me to be explicable, not on the hypothesis taken up by later observers that it is an effect of cold, but as being a result of long-sustained domestication; and if what Hehn, p. 413, *l. c.*, suggests as to the South Russian breed of small red steppe cattle being descendants of those Scythian oxen is true, we should have a further confirmation of this view furnished in their persistency. There is, at any rate, another breed of cattle in the South Russian steppes, which goes by the name of the "Kalmuc" cow, and is supposed to have accompanied the Mongolian or Tartar hordes in their invasion of Europe.

Some writers, in defiance of the arguments that have just been glanced at, and of many others, have advocated the claims of Africa to be considered the parent country of the domestic ox. The main fact, as it seems to me, which has induced or seduced them rather into this conclusion, is the great extent to which bovieulture has developed itself through the length and breadth of the "Dark Continent." But without wasting words in pointing out the curious conclusions to which this reasoning would lead us in other cases, I would refer such persons to Middendorff's account of the development which this same boviculture has attained in Siberia, and to his statement that not only have the nomads of the southern steppes, the Buráts, the Mongols, and the Kirghiz, herds numbering thousands and tens of thousands wintering out in the open, but that even the Jakuts by, it is true, taking more care of their cattle, have, from being simply nomads, become a pastoral people of distinction, and even "improved cattle-breeders!" ('Sibirische Reise,' iv. 2, 2, p. 1323.)

Coming, in the second place, to the consideration of the sheep, I must allow that considerable hesitation has been expressed by

many writers as to the question of its parent-stock; and that doubt may be not altogether unreasonably felt as to whether that stock may not have become extinct, as the parent-stock of the cow has all but entirely done. But what I know of the deerlike agility and watchfulness of some of our European mountain breeds of sheep, and in the second place what I see of the smaller size of the animal as giving it a less severe battle to fight for its survival, makes me slow to think that their parent-stock need be thought likely to have perished as has that of the larger ruminant. And setting this view aside, we may say that either the Mouflon (*Ovis musimon* and *cyprius*), with a range from Majorca to Cyprus, and not without footings, occupied by such varieties as *Ovis orientalis*, and *Ovis Vignei*, on the mainland on various points of the mountain-ranges of the Taurus and of Armenia to those of Tibet; or the Argali, *Ovis fera Sibirica* s. *Ovis Argali*, with an all but equally extensive range from the Pamir range just above Samarcand and Bokhara to the Sea of Okhotsk as *Ovis nivicola*, or *Ovis polii*, must be credited with having given to the world this inestimable gift. If it shall really turn out to be true that a true Argali, that is to say a variety of wild sheep, in which both sexes carry horns, had been found in the Taurus, as Ainsworth (*cit.* A. Wagner, 'Die Geographische Verbreitung der Säugethiere,' Abhandl. d. ii. kl. d. Ak. d. Wiss. München iv. Bd. Abth. i. p. 139), and Ritter ('Erdkunde,' xi. 506), have averred is the case, the claims of the Argali would to some persons, I apprehend, appear to be stronger than they may do if its range should, as I incline to think it will, be shown to be confined to the more easterly limits just given. But under any and all circumstances, the fact that the female Mouflons have no horns, whilst the female Argalis have them, though smaller in size no doubt than those of the male, when coupled with the fact that in the older breeds of domestic sheep both sexes carry horns, appears to me to be conclusive in favour of the Central Asiatic Wild Sheep. As regards the Natural History arguments I shall content myself, and I daresay others also, by referring* to the already quoted eleventh fascicle of Pallas's 'Spicilegia,' and to Isidore Geoffroy

* I may add a few words from the already quoted memoir by Andreas Wagner, *l. c.*, p. 137. "Hochasien ist recht eigentlich das Vaterland der *Wildschafe* und *Wildziege*, die hier in zahlreicher Menge und in sehr verschiedenen Formen vorhanden sind. Ob diese alle gesonderte Arten oder nicht vielmehr viele von ihnen nur Rassen von Hauptarten ausmachen, ist eine Frage die noch lange nicht beantwortet ist." Mr. Wallace's suggestion ('Geographical Distribution,' vol. i. p. 232), that the vast plateau of Central Asia may, in comparatively recent geological times, have been much less elevated, and may then have been much more fertile than it is now, deserves more than this simple mention.

St. Hilaire's 'Histoire Naturelle,' iii. pp. 86–87, *ibique citata*, but I would add a couple of facts from the linguistic side of the mass of arguments available for deciding the question. The first of these is as follows:—The early Accadian inhabitants of the plains of Babylonia, when they gave an epithet to an animal, very frequently chose it from the locality whence they supposed the animal to have been derived. And the epithet which they bestowed upon the sheep was "num," or "numma,"* which means "the highlands," and which, as applied by people living in those wide plains, and as being applied by them to the wolf also, has a very obvious significance. It is true, as anybody may convince himself by consulting Bochart's 'Hierozoicon,' ii. 2, p. 516, that poets and other writers, Aryans and Semites, Greeks, Romans, and Arabians indifferently, have connected the sheep, as they saw its habits, with mountainous scenery and surroundings; what is of special importance in the epithet as used in the Accadian column of the bilingual Assyrian inscriptions is, that it was used in such a country and in such early, not to say such unpoetical, times.

My second linguistic fact tells, as it seems to me, strongly in favour of not merely the Asiatic but of the Mongolian origin of the domestic sheep; it appears, I mean, to point to a more or less limited area in the wide field of Asia as having been the particular spot, or at any rate one of the particular spots, where a wild sheep was brought under domestication. This fact as given by Ahlquist in his interesting work, 'Die Kulturwörter der Westfinnischen Sprachen,' 1875, p. 14, is to the effect that the Tatars, by which word he means presumably Turkic and Tungusic tribes, in the neighbourhood of the Lake Baikal, have words of their own for ram and ewe, *täkä*, to wit, and *sarik*, which the Tscheremissians, who live now as far away from that lake as is the river Volga, use as loan words. It is, I submit, not easy to imagine that a word would have maintained its life thus intact and vigorous if the thing which it represents had not been part of the national life of the tribe using and retaining it. And this suggestion gains in force when we learn from the same authority, *l. c.*, that the Hungarian language has adopted Slavonic words for the ewe, the ram, and the lamb, and find him deducing from this the conclusion that the Hungarians, albeit a steppe tribe, had not been shepherds before they came into relation with the Slavs. It may have been due to this, but it may also have been owing to a prepotency either in the

* For these facts see the Rev. W. Houghton 'On the Mammalia of the Assyrian Sculptures,' Trans. Soc. Biblical Archæology, v., 1, 1876, pp. 3–7, *ibid.* 2, 1877, p. 42. 'Gleanings from the Natural History of the Ancients,' 1879, pp. 12–89.

Aryan language or in the pastoral craft of the Slav race. For except upon one or other of these latter hypotheses, it is difficult to see why the Tcheremissians on the Volga should have retained their Mongolian names for the ewe and ram, whilst not only the Hungarians but the Ostjaks, the Vogals, the Mordvins, the Syrians, and the Wotjaks, from the Volga to the Irtisch, should be using more or less modified Slavonian words for the same things. Anyhow, that a lowly, organised language, such as the Tataric, should have words of its own for the domestic ewe and ram, is a point of great significance, especially when we consider that these Tatars lived around the spurs of the Altai range on the lower and middle zones of which the Argali was then, as now, available for the purposes of domestication.

Thirdly, of the horse. The fossil or semifossil bones of the horse, *Equus caballus*, are found in the lower Thames valley gravels under our feet, and from this area of the world's surface all the way to the regions round the Lake Baikal; and in this latter district the horse is found, as I think may be safely said, in a wild state at the present day. It is true that a very large number of naturalists of the first rank, such as Mr. Darwin and Mr. Wallace, have acquiesced in the view which teaches that the so-called "Tarpan" is but a "feral" animal, the offspring of runaway stallions and mares from the steppe droves. But it is also true that the small number of naturalists of the first rank *who have travelled over the Russian steppes*, viz. the younger Gmelin, Pallas, and Middendorff, are of the contrary opinion; and that whilst acknowledging that the steppe horse, like, perhaps, all other domestic animals except the sheep, may lapse into feral habits, they hold to the view that the true "Tarpan" is a descendant of the pristine wild stock, whilst the "Musin" is but a steppe horse run wild.*

* See Middendorff, 'Sibirische Reise,' iv. 2, 2, pp. 1308–1321. Gmelin, 'Reise durch Russland,' i. 45, 1770, and for drawing Tab. ix.

It may be well, for several reasons, to give the exact facts as to the opinions which Pallas held at various times respecting the feral or the truly and aboriginally wild character of the so-called wild horse of the Steppes. In 1769 (see 'Voyages de Pallas,' French translation, 1788, vol. i., p. 324) Pallas inclined to the view of the Tarpan being simply a feral race; and he repeated this opinion in 1773 (see *l. c.*, vol. v. p. 90). But in 1776, in the eleventh fascicle of his 'Spicilegia Zoologica,' p. 5, he expresses himself to the following effect: "Equi feri in campis Bessarabicis circaque Tanaïn et per omnem Tatariam magnam in desertis vagantur gregatim, *magnam quidem partem* fugitivis Nomadum equis permixti atque multiplicati; ideoque versicolores; *aliqui tamen habitu toto a cicuratis adeo discrepantes ut primitiva de stirpe feros esse dubitari vix posset.* Conf. de iis qui ad Tanaïn atque in eremo inter Volgam et Jaikum habentur" S. G. Gmelin (the younger Gmelin), 'Reisen durch Russland,' vol. i, p. 44 seq. et Itinerarii nostri, vol. i. p. 211; et vol. iii., part ii., p. 510." See also the posthumously (1831) published 'Zoographia Rosso-Asiatica,' vol. i. p. 260.

To these references I would add the 'Geographische Geschichte,' i. p. 181. 1778.

The main argument for the descent of the wild horses of the steppes from the domestic or semi-domesticated stocks of the Turanian nomads, rests on the fact that a great variety of colour is observed to exist in the free droves. This, however, appears to me to prove nothing more than that the tame and wild varieties breed freely together.* I myself, long ago, succeeded in maintaining numbers of feral rabbits, parti-coloured with white, on an area already occupied by the ordinary English wild rabbit. The feral rabbits never attained an equality in numbers with the gray stock, but being spared in shooting, whilst the wild stock was not, they maintained themselves for a considerable number of years in what was for themselves as against predatory attacks of various kinds an only too conspicuous prominence. But nobody would have argued from this that no wild stock could be held to exist on that area. Still though we may follow the highly trustworthy naturalists and travellers just mentioned as to the persistence of the aboriginal horse in a wild state on the Turanian steppes, we have yet to show that it is probable that it was on those steppes rather than in any other part of the wide area over which the true wild horse once ranged that it became reduced to domestication. And here again the Accadian inscriptions come to our assistance; the horse being called there (see the Rev. Wm. Houghton, *l. c.* 1876, p. 3), "*imiru Kur-ra*," "the animal from the East." We see from this that these ancient Turanians claimed, and had their claim acknowledged, that the taming of the horse was an achievement wrought out in the cradle of their race. I have sometimes thought that the ascription by the Greeks of this feat to Poseidon may be similarly taken to indicate that they had some sort of dim conviction that the horse had come to them from the countries beyond the Egean. This, however, may be an overstraining of the value of such hints. But the history of the horse, whether dug out of Pile-dwellings and Neolithic interments, or out of records such as those in Genesis and Exodus, show that it came comparatively late into use, as a domestic animal at least, in the regions to the west of the Central Asiatic plains.†

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of the zoologist Zimmermann. Writing only two years after the appearance of Pallas's Memoir just cited, Zimmermann not only entirely accepted the view given above in italics, but *l. c.*, p. 204, speaks in not exaggerated terms of Pallas as "der erste aller von mir gekannten Reisenden."

* The Mongols and Kalmucks, from superstitious motives, take great pains to secure various colours for their domestic horses, sheep, and goats. Hence some of the variety in the feral horses. See Pallas, 'Mongol. Volk.' i. pp. 117, 178, 179.

† See further, Lenormant, 'Premières Civilisations,' tom. i. p. 322; Ahlquist, 'Die Kulturwörter der Westfinnischen Sprachen,' 1878, p. 9; 'Spectator,' April 27, 1878, *ibique a me citata.*

The fourth of the domesticated animals, which I have spoken of as having in great probability had a Central Asiatic origin, the goat, namely, has its claims, supported by the vast majority of naturalists without any hesitation. The wild *Capra ægagrus* of the Taurus, of the Caucasus, of the Persian mountains, and of Kirghiz and Tatar districts, "possibly mingled," says Mr. Darwin, 'Domesticated Animals and Cultivated Plants,' i. p. 105, "with the allied Indian species, *Capra Falconeri*," may be safely taken as the parent-stock of this animal. The Tibetan and Angoran varieties of the goat, by their well-deserved reputation, may seem, even in these days and under the light thrown on the subject by the book just quoted, to lend some support to Col. Hamilton Smith's principle,* that where the largest and most energetic breeds of a race exist, there we may look for their original habitation.

It is thus seen that four out of the twenty-one domesticated mammalia may, with very considerable probability, be supposed to have been first domesticated in Central Asia, and though the non-cosmopolitanism of the two camels, *Camelus bactrianus* and *Camelus dromedarius*, renders them less available for my present purpose, that, viz., of pointing out the great changes which man has effected in transporting into all parts of the world what he found only in some more or less circumscribed portions of it, the facts of the Central Asiatic origin of the two-humped variety or species, and of the South-western Asiatic, or at least Arabic, origin of the one-humped dromedary, bear not a little on the whole question.

I do not omit the dog and the pig† from the list of the ani-

* These are Col. Hamilton Smith's views (Nat. Library, "Dogs," vol. ii., p. 163, *cit.* Rev. Wm. Houghton, *l. c.*). Speaking of the possible derivation of the greyhound from an Asiatic home "somewhere to the westward of the great Asiatic mountain chains where the easternmost Bactrian and Persian plains commence, and where the steppes of the Scythic nations spread towards the north," Colonel Hamilton Smith says, "when we look to the present proofs of this conclusion and assume that where the largest and most energetic breeds of the race exist, there may we look for their original habitations, we then find, to the east of the Indus, the very large greyhounds of the Deccan, to the west of it the powerful Persian breed, and to the north of the Caspian the great rough greyhound of Tartary and Russia, and thence we may infer that they were carried by the migrating colonies westward across the Hellespont, and by earlier Celtic and later Teutonic tribes along the levels of Northern Germany as far as Britain." It is curious that Colonel H. Smith should not in this connection have mentioned the Thibetan dog, figured by himself, *l. c.*, with the tan-coloured supra-orbital stripe, common so significatively to this variety *and* to the Mexican Alco. For the Thibetan mastiff has long been known to be one of the largest varieties of the species, and quite recently (see 'Times,' Dec. 26, 1879) Mr. Baber, the consular resident at Szechuen, is reported as writing of them as the largest dogs he had ever seen.

† That the Central Asiatic wild boar lends itself readily to domestication is thus expressed by Pallas, 'Zoographia Rosso-Asiatica,' p. 269. "Porcelli cicurari assuescunt facile et cum domesticis generant." And Radde's words ('Reisen

mals which there is good reason, to my judgment, for thinking were domesticated in Central Asia, because I do not think they were domesticated within that area, but because, I cannot deny, that it is probable they were also domesticated elsewhere. But it may fairly be suggested that the art, skill, and craft of domesticating these and the other six animals having been first learnt in Central Asia, spread thence; and that thus all or nearly all the acquisitions which man has made in the way of domestication, may thus owe their origin, if not in the way of actual blood-lineage, yet in that of being the fruits of man's experience acquired there, to the district in question.

I pass by a natural transition to point out very shortly, not the cardinal necessity of the possession of the sheep, goat, ox, horse, camel, pig, and dog, for food and clothing, for locomotion, and for carrying on the processes of the hunting, of the pastoral and of the agricultural life; but how that necessity has been unconsciously recognised by man in certain of his earliest institutions.

Of these seven mammals, six are now distributed over the face of the whole habitable world; but long before this had become the case with any one of them, except possibly the dog, man had expressed unconsciously, if not quite inarticulately, his recognition of their value by using them in one way or another for one or another of his most sacred rites and ceremonies. The single Latin word SUOVETAURILIA denoting a particular kind of sacrifice of the swine, the sheep, and the ox, which is figured on many a tablet found in this as in other countries, and was performed at great crises of Rome's fate, may suffice as regards the three animals which speak so plainly to our eyes in those sculptures. To Eastern and to Western people it was indifferent (see Exod. xii. 5, Ps. l. 9, and classical writers *passim*) whether sheep or goats were taken out of the fold for this purpose. As regards the dog, Livy (xl. 6) tells us that in the Purification of a Macedonian army the two halves of a dog's

in Süden von Ost-Sibirien,' 1862, i. 236) are as much or more to the point, as they apply to adult animals: "so muss ich gestehen, dass sie sehr friedlicher Natur sind und es mir mehrmals passirte mittelalte Wildschweine sich mir bis auf vier Faden weite nahen zu sehen." If the so-called "wild" boar is as tame as to allow this so many centuries after the invention of gunpowder, it is easy to understand that it may have been much more amenable to man's influence thousands of years before that discovery. As regards the dog, it seems probable that even within the limits of the Central Asiatic region we are dealing with, two very distinct wild stocks may have furnished corresponding tame ones. The large Indian dog, or Hyrcanian dog of the ancients, may very reasonably be supposed (as suggested by Fitzinger) to have been the parent-stock of the modern Thibetan mastiff, whilst Pallas says that the Kalmuck domestic dog is so like the jackal of the same region that it is impossible not to consider them identical. *See* 'Spicilegia Zoologica,' Fasc. xi.

body were placed, one on one side, one on the other, of the road along which the soldiers were passed. Similarly, we are told by the Arab Ahmed Ibn-Fozlan, who must have witnessed the proceeding with a good deal of repulsion, that a dog was cut in half and put into the ship in which a Norse chief was burnt in the tenth century on the banks of the Volga (see Anderson, 'Proc. Scot. Soc. Antiq.,' May 13, 1872, p. 522); and I have myself taken up, not without some effort in overcoming a certain reluctance, the bones of a dog who was keeping his mistress faithful company in a grave undoubtedly of the earliest Neolithic period in England.*

As regards the horse, Achilles, fresh from his conversation with Xanthus and Balius, tells the Trojans (Il. xxi. 132) that even their wonted sacrifices of horses will not profit them; the Mongols (see Howorth's 'History of the Mongols,' i. 262, 289; and Yule's 'Marco Polo,' i. 265, *cit. in loco*), the Lusitanians (Livy. Epit. 49), and the Norsemen (see Ibn Fozlan, *l. c.*), all alike sacrificed horses on great occasions.

I have not found, nor did I expect to find, any account of the sacrificing of the camel, either in Semitic or classical literature; if, however, it be a sound principle that races as yet uncivilised would be likely to sacrifice or otherwise deprive themselves upon great occasions of the services of their oldest and most valued domesticated animals,† we ought to be able to show

* See 'British Barrows,' p. 518, 1877; 'Journal Anthropological Institute,' October 1875, p. 157.

† As I am speaking of animals domesticated in Central Asia, I have not mentioned the ass which, as Dr. Sclater has shown ('Proc. Zool. Soc.' 1862, p. 164), owns as its parent-stock the *Asinus tæniopus* of Abyssinia. Its history gives, however, an illustration of the principles enunciated above at least as striking as those of any of the eight Asiatic mammals just specified. From the references made to this animal in the Pentateuch, it would appear to have been domesticated in the region there treated of before either horse or camel, though subsequently to the ox. Pindar's reference to it as used for sacrifice by the Hyperboreans (Od. Pyth. x. l. 52) will be to persons who will bear in mind its African origin almost as convincing evidence of the great antiquity of the date of its domestication as its appearance on the oldest Egyptian monuments of the Fourth Dynasty. Hecatombs, such as Pindar speaks of, are, numerically, figured on one tomb, reproduced for us by Lepsius. That the ass should so early have been introduced into Hyperborean regions even by a poet is a little surprising, considering that the horse, which is so much better suited for such climates, was already available there; but besides being surprising it is also significant. For the sacrificial and ceremonial use of this animal, see Orelli's 'Excursus ad Tacit. Hist.' v. 3, vol. ii., 1848, of his edition of the great historian, *ibique citata*. Dean Stanley's 'Jewish Church,' i. 96, *ibique citata*. 'Pindar, ed. Dissen and Schneidewin,' sect. ii. 1847, p. 353, *ibique citata*. For the linguistic Palæontology of the name, see Lenormant, 'Origines de Civilisation,' i. 319. For the use of the animal by the modern Hyperboreans see Middendorff, 'Sibirische Reise,' iv. 2, 2, p. 1322, where, however, that great naturalist, albeit reckoning "Pferdekenntniss und Pferdezucht als seiner Specialität," or one of them, leaves the difficulty above hinted at unexplained.

that the Central Asiatic nomads did so by the "ships of their deserts." And I find in Mr. Howorth's valuable 'History of the Mongols,' i. p. 426, the following passage :—

"Ssanang Setzen now goes on to tell a story which crystallises for us a very curious phase of old Mongol manners. Altan Khakan had a son called Pubet Paidshi. The young man died, and his mother determined to kill 100 boys and 100 foals of camels, which were to be buried with him, and to accompany him as an escort to the other world. She had killed over forty boys when a tumult arose among the people."

Here I think I may leave this part of my subject, the significance of this series of facts being sufficiently self-evident. For as against these seven domesticated mammals which Central Asia may with so much probability claim as being her gifts to mankind, inasmuch as she either herself furnished their parent-stocks, or at any rate furnished the necessary opportunities for gaining the knowledge subsequently used in domesticating similar stocks elsewhere, what can all the rest of the habitable globe set either as regards cosmopolitanism or as regards importance? As regards importance the other thirteen are all but insignificant; as regards cosmopolitanism, universal importation, that is, either for purposes of practical utility or *animi voluptatisque caussa*, as Cæsar put it, we can mention but the African cat and the African ass.

I come now to the consideration of the facts and views with which botanists have supplied us as to the original homes of our cultivated plants. Our own inspection and recollection of the landscapes of the various countries in which we have travelled will enable us to estimate the greatness of the change, which man's migrations and transportations have effected in the sphere of all his labour under the sun. And I will begin what I have to say under this head by the apparent paradox that the argument which our cultivated plants furnish us with for determining the locality whence man issued to occupy the world and subdue it, and alter its external appearance, would, like some other arguments, have appealed with greater force to one of the civilised races of antiquity than it does at first sight to us. It is, herein also like some other arguments, cogent for all that. Let us state it. Fifty per cent. of our cultivated plants have been shown by De Candolle, 'Géographie Botanique,' pp. 986, 987, and by Élisée Reclus, 'The Ocean' (English Trans. ii. chap. 27, 292), following him, to belong to "Europe" and "Asie septentrionale et occidentale," that is to say, to the Palæarctic Region of Zoogeography. So far the figures are equal for cultivated plants and for domestic animals, and I do not feel it necessary

to dwell upon the differences which the other proportional numbers show as regards Africa proper and South America. What is of importance, however, to point out, is that to anybody living, not merely before the time of Columbus, whose discovery has been said to have acted upon the Old World much as the approximation of a new heavenly body, planet, or other, might act upon the whole earth, but before the time, say, of Tacitus and Agricola, what Africa and India had given him in the way of cultivated plants, would have seemed just as insignificant as what, putting the ass and the gallinacean birds out of sight, they had given him in the way of domestic animals. He might, if living in Italy, have said, as did Columella (iii. 9, 5, *cit.* Hehn, p. 423 *l. c.*), "Curæ mortalium obsequentissima est Italia, quæ pæne totius orbis fruges adhibito studio colonorum ferre didicit," and pointed out beforehand the airy inaccuracy of Goldsmith's apostrophe to that country in his 'Traveller.' He might, I am inclined to think, with the evidence available to him, have pointed out, and correctly, that the middle zone of deciduous trees which girdled then, as now, so many of the Italian hills with a belt of chestnuts, and much, therefore, of its distinctive character, was due to the intercourse of Rome with Pontus and Galatia in pre-Christian times. And he might have drawn thence the same conclusions which we may, I think, also draw as to the area on the world's surface whence man set forth westward on his career of occupation, having, as he had, available for his wants, vegetables, plants, and trees of no less value, and of no less prominence in the landscape, than are these of Palæarctic, though not of Italian, origin, viz., wheat, barley, rye, oats, spelt, buckwheat, millet (*Panicum*), peas, beans, hemp, flax, cabbage, turnip, plum, walnut, vine, cherry, olive. Of tea, coffee, sugar, even of rice, of oranges, and of several other of the gifts of the Indian region; or of coffee, or any one of the three, or four if we include *Musa ensete*, now flourishingly growing in Sicily, gifts of Africa proper, a man living at that time had as little knowledge as he could have had of the gifts to come from the still undiscovered New World, of the potato, of maize, of the pineapple, to which his all alien stone pine was to lend its name, of the equally incorrectly named artichoke, of the tomato, now somewhat variously obtrusive or intrusive in Mediterranean regions, or of tobacco, or of the prickly pear, or of the agave, though of the two latter in reference to what was then, and is still, such a large part of human activities, it can be said, as by Admiral Smyth (p. 17 of his 'Memoir of Sicily and its Islands,' 1824), that they "form impenetrable palisades for fortifications, and in the

plains present very serious obstructions to the operations of cavalry."

My third map, with the distribution of the vine after Schouw, should be compared with my picture from Kaempfer's 'Amœnitates Exoticæ,' Fasc. iv. p. 711, 1712, of what he calls, p. 714, the *Messis dactylifera*, the date-harvest of Persia, and speaks of as being *lusus magis quam labores*. The distributional limits of the "fruitful" vine and the "fruiting" date-palm now, as of yore, overlap each other, as was pointed out by Arago in his 'Mémoire sur l'État Thermométrique du Globe terrestre' ('Œuvres,' v. 216, ed. 1858) in Palestine, when from this fact, he, with much ingenuity, argued that 3300 years have not appreciably altered the climate of Palestine. For "la limite thermométrique en moins de la datte diffère très peu de la limite thermométrique en plus de la vigne;" and, what makes the argument, especially to those who have Kaempfer's picture of the luxuriant date-harvest before their eyes, entirely and beautifully perfect, he further (p. 217, *l. c.*) tells us, "à Abusheer (Bushire) en Perse, dont la température moyenne ne surpasse certainement pas 23°, on ne peut, suivant Niebuhr, cultiver la vigne que dans les fossés ou à l'abri de l'action directe des rayons du soleil." A more simple, but also a more conclusive proof that the Syrian climate has not materially changed within the historic period cannot be imagined.*

I began this Lecture with details as to the distribution of pines and firs by man's agency; I may fitly close those details by attempting something as regards that of one of the palm tribe. For, though Leopold von Buch was wrong in holding that the two natural orders were altogether mutually exclusive as regards natural geographical distribution, as a voyage in the

* It is strange to find that Arago could, when dealing with France, have swerved so far from the line of evidence he employed as to Palestine, as to have told the Chamber of Deputies (February 27, 1836): "Vous serez peut-être étonnés d'entendre que dans les environs de Paris, il y a quelques siècles, il faisait beaucoup plus chaud qu'aujourd'hui," vol. xii. 'Œuvres, Mélanges,' p. 434. But for the context one might have been tempted to take the last of the words just quoted as applying to the month of February only; and in all gravity the title of chapitre xix. in the memoir already quoted, vol. viii. 'Œuvres,' vol. v. 'Nat. Scient..' p. 239, "Observations prouvant que l'ancien climat se maintient dans une partie des Gaules," might seem to justify such an interpretation of words spoken under some provocation in debate. And the more so as a few pages previously (p. 214) we find Arago recognising the essential deceptiveness which must attach to "une foule de documents historiques" in the following words: 'On remarquera que je devrai résoudre le problème que je me suis posé sans avoir recours à des chiffres certains, à des observations numériques. L'invention des thermomètres ne remonte guère qu'à l'année 1590; on doit même ajouter qu'avant 1700 ces instruments n'étaient ni exactes ni comparables."

Mediterranean, or the sight of Martius' picture of *Brahea dulcis* (vol. iii. taf. 162) side by side with a true pine in Mexico, teaches us, there can be no doubt that Cæsar and his countrymen were, speaking generally, right in holding the fir and the beech to be as characteristic of Gaul and Britain as their repeated allusions and their coins show them to have thought the palm was of Palestine and the adjacent countries, at least eastward and southward.

What, then, do we know, firstly, as to the original home or botanical region to which the date-palm, *Phœnix dactylifera*, belongs? and secondly, what can we surmise as to the particular spot in that area in which that tree was first made available as a cultivated plant, and subjected to those human influences which three of my pictures are intended to illustrate?

As to the first of these questions there is no doubt, and no occasion for any very lengthy answer. The region which Grisebach names, after its principal constituent element, simply, "Sahara," and which stretches over more than 90 degrees of longitude from Macaronesia to Multania, from the Canaries, that is, to the Great Desert of Rajputana, and which comprehends not only the Sahara strictly so-called, but cis-Saharan Africa also, from the longitude (E. 10°) of Tunis eastward, and not only old Egypt and Arabia, but young "Egypt," or Sinde also, is the botanical region of the date-palm. Sir Joseph Hooker ('Morocco and the Great Atlas,' 1879, p. 409) has pointed out that there are many Canarian plants which form an exceedingly interesting group, the members of which, though chiefly Egypto-Arabian, are found to extend in some instances even into Western India, and he suggests that "it is not unreasonable to suppose that such have covered Africa in a sub-tropical latitude, and thus reached the Canaries under conditions now operating." Other plants, therefore, if not other trees, may have spread over the same area, whether by man's aid or without it, and may be taken as equally characteristic of it, even though they may not need so much "water to their feet and fire to their heads." It is, *per contra*, I may remark, by a surplusage of water to the head and a noxious quantity of heat to the feet, that the latitudinal limits, south and north parallels, of the date-palm are given. If, as Dr. Daubeny suggested ('Lectures on Climate,' 1863, p. 86), we have, as in certain truly tropical (and continental) countries, heavy falls of rain during that particular time of the year when the pollen should be carried to the pistilliferous flower, this latter will not be fertilised (unless by man's interference), the dicœcious character

of its flowers putting it thus, as it does also *Borassus flabelli*, at a serious disadvantage as compared with the coconut-palm,* *Cocos nucifera*, whose company they, in consequence perhaps of a sense of this their inferiority, appear to avoid.

On the other hand, the requirement of a mean temperature of from 70° to 81·5° F. excludes the date-palm from bearing dates, except under specially favourable, and therefore only locally prevalent conditions, eked out by human protection, on the north shores of the Mediterranean;† all the way from Alexandretta, where it still grows, to Gibraltar. The solitary, and for this as for other reasons unfertile, palms which we still see here and there in the Ægean and along the region of the west

* It is not only the "tempest's wrath," but also the "battle's rage," which the dicœcious character of the date-palm helps in the work of destruction. The pictures from Lepsius's Egyptian Denkmäler which I have had copied for this Lecture show that this was known in the time of those "great old houses and fights fought long ago." History tells us that Norman and Saracen (see Admiral Smyth's 'Sicily,' p. 19, 'Martius,' iii. p. 262), Anjou and Arabian generals have, each alike, in defiance either of the letter or of the spirit of their professed religion, or of both, cut down the male palms, and so prevented *pro tanto* the reproduction of the tree with 360 uses to mankind. The modern Arabs, according to Rohlfs, 'Afrikanische Reisen,' Aufl. 2, 1869, p. 70, *cit.* Helm, *l. c.* p. 513, appear sometimes even in very severe military operations or devastations to spare the palm even when cutting down other fruit trees. But Abd-el-Kader appears to have had some transgressions even as to palm-trees on his conscience to repent of. The solitary palm, the existence of which von Baer reports to us on a certain peninsula on the south shore of the Caspian, called in our maps the Peninsula of Mejankal, but in his apparently, and curiously, the Peninsula of Potemkin, is, I should think, a solitary survivor of some such proceedings as those figured in my Egyptian pictures. Von Baer himself looks upon it as a survivor of companions not destroyed by the art and malice of man, but by local refrigeration, due to the extinction of certain volcanoes which were active even in comparatively recent times. *Verecunde dissentio.*

† Martius writes on this subject, *l. c.* iii. p. 263, as follows: "Hæc igitur habuimus quæ de incremento, quod arbor illa capit in imperio floræ per Europam meridionalem patenti, diceremus. Ex quibus intelligi potest *omnino ut nascatur* arte effici, cogitandumque nobis esse eam plures culturæ gradus intra fines quos occupaverit percurrere. Quæ si ad summum ascenderit flores emittit, fructusque dulcis et boni saporis edit, et si *manu et arte accedente fecundetur*, etiam semina ad propagandum idonea gignit; quod fit in Hispaniæ parte ad meridiem versus remotissima, in Sicilia, in Græciæ promontoriis maxime ad meridiem vergentibus, et in insula Cypro (nimirum sub lat. bor. 35° et medio calore annuo 18° C. ad 20° C.) In altera zona flores quidem et fructus fert, sed fructuum caro non plane excolitur, quum acerbi sit saporis, fructificatio nulla, semina cassa: huc pertinet tractus littorum maris Mediterranei in Gallia meridionali, in Italia, in Sardinia, item regionis Dalmatiæ, Insulæ Ionicæ, Græciæque septentrionalis. Cujus zonæ terminum septentrionalem posueris fortasse 41° 20′–45° *lat. bor.* In tertia linea palam durat quidem sub divo, sed flores aut raros aut nullos emittit: immo frondescit tantum; cujus zonæ terminus septentrionalis tendit ut commemoravi, per insulas lacus Verbeni sub lat. bor. 46° media anni temperie a 12° usque ad 13° C. Arbor hic provivere potest, etiam si hiemis temperies interdum sub frigoris gradum deprimatur dummodo ne nimis (forsan ad — 3° vel 4° C.) accedat, quo frigoris etiam mali medicæ, citri, aurantii, et myrti extingui atque opprimi solent. Superior altitudinis terminus in monte Aetnæ usque ad pedum 1400 vel 1680, teste viro cl. Philippio, adscendit."

and north shores of Asia Minor, short of the Black Sea eastward, and which still strike us as being something as alien to that landscape as was the seedling-palm at Apollo's Delian temple to the eyes of the much-travelled Ulysses (Odyss. vi. 162), have been planted there not as "food-plants," but *animi voluptatisque caussa.*

As regards the particular and single spot in the vast botanical region, if particular and single spot there really was, upon the longitudinally vast area upon which the date-palm was brought under that human influence which has since caused it to effloresce into so many varieties, very various opinions have been advanced, and I propose to add a fresh one to their number. It may appear at first sight that such a discussion and such an attempt have in themselves an intrinsic futility. We do not need to refer to King Juba's report of his exploratory voyage to the Canaries to learn that the date-palm will bear dates even in an oceanic and uninhabited island, and some persons may think that we need only, like the wits of Charles's time, to study ourselves and our sensations to see how the forefathers of the Guanches, when they in some post-Juban or post-Augustan period occupied the island, would, under the stimulus of hunger alone, come to learn the art of date-culture, even if they had not brought the knowledge of it with them. Still, I think, on the doctrine of chances, or, what comes to the same thing, the principle, "*Frustra fit per plura quod fieri potest per pauciora*," as well upon certain concrete arguments furnished by the Egyptian monuments on the one hand, and by certain curious but still life-like and truth-like stories on the other, which I find in Herodotus, though other writers have not quoted him *ad hoc*, that it is not unreasonable to suggest yet another site for the one where man first intermeddled with the self-preservation and the species-preservation of the date-palm.*

* It is a little amusing to find twenty-two pages, 289–311, of Seemann's 'Popular History of Palms' devoted to discussing the questions whether the date-palm was an "endemic (genuine) member of the Canarian Flora," and "whether it was indigenous to the Canary Islands." This book was, however, published in 1856, and though something, and perhaps too much, was even then ascribed to "occasional causes" in the explaining of anomalies in geographical distribution, a good deal has been learnt since that which would have rendered that dozen of pages impossible. It is remarkable that the author did not use the arguments supplied him by Dr. Carl Bolle in support of the Atlantic hypothesis, which since those days has been buried as deeply as the Atlantis itself was supposed to have been. Of course another question, not raised indeed by Dr. Seemann, as to whether the art of artificially cultivating the date could have originated in what we now know to be oceanic islands and spread thence eastward is, by the knowledge we have since 1859 gained as to 'Man and Nature' in their independent as well as in their mutually interacting operations, rendered all but an impertinence. We (see Darwin, 'Animals and Plants under Domestication,' i. p. 328, 2nd ed.) "do not

Kaempfer, from whose opinion I dissent with the greatest reluctance when I consider the thoroughness with which that model traveller availed himself of his opportunities, and the abundance of those opportunities themselves, gives us his views as to the place in which the palm in question was first cultivated by man, in the following words (p. 714) of his 'Amœnitates Exoticæ,' Fascic. iv. 3, published in 1714: "Ejus patria in Asia quidem, nam Africam non moramur."

Ritter ('Erdkunde,' Theil xiii. p. 771 *seqq.*) considerably narrows this area by selecting the Babylonian Nabatæans in the valley of the Tigris and Euphrates as having been the people who discovered and first practised the art of improving the date-palm. But Professor Rawlinson, in a letter to me, gives "B.C. 1500, or even earlier" as the possible date of a probably early Babylonian cylinder figured with palms in his 'Ancient Monarchies,' iii. p. 23, 2nd ed., and "B.C. 883" as the earliest date for Assyrian figures representing palms; whilst the Egyptian Twelfth Dynasty, which possessed the tree, carries us back to from 1860 B.C. to 2200 B.C., according to Wilkinson and Brugsch respectively.

Unger, 'Sitzungsberichte k. Akad. Wiss. Wien,' Bd. xxiii. Hft. i. p. 204, 1857, suggested the countries on the eastern side of the Persian Gulf as the centre whence in the very earliest times of commerce and international intercourse this plant was carried over Arabia, Persia, Hindustan, and North Africa. But he, in a later Memoir, published after travel in Egypt, *ibid.* xxxviii. pp. 75, 104–106, 1859, quotes Delile as averring that, *valeat quantum valeat*, the Egyptians themselves considered that Arabia Felix was the original country of the date-palm; and by twice (*ll.cc.*) mentioning the fact that Egypt itself is called not only the land of the sycamore, but also the land of the palm-tree, he would appear to assign the same weight to that tradition which I have felt justified in assigning to those embodied in the Accadian Inscriptions. Unger himself suggests, though very guardedly, that the date may have been imported into Lower from Upper Egypt. He is, as such a botanist would be sure to be, careful to disclaim any acceptance of the cogency which others have assigned to an argument based on the luxuriance of growth which the tree does attain in the locality in question. "There is nothing in all this, however,

believe that any edible or valuable plant except the Canary grass has been derived from an oceanic or uninhabited island." It is only just *not* an impossibility that the date-palm should have been so derived; if it had been, this would indeed have been something more surprising than all the usefulness of the tree, than all its beauty, and even than all the blunders which have been made about it.

to hinder us from supposing that the palm does so flourish there, because in its migration from the north southwards it came in the latter place for the first time upon the soil best suited to it."

Martius, on the other hand (*l. c.* iii. 263), uses this very argument for assigning the original site of the date-palm to the southern part of Tunis, "Blad el-Dscherid," as he writes the name of the locality, *h. e. arida terra*, "falso nuncupata Biledulgerid," as he adds, "Beled el-Jerid," I may add as named in Johnston's Royal Atlas in lat. N. 34°, long. S. 10°. "Quo loco," says Martius,* "solidæ conspicientur palmarum sylvæ *tanquam in prima patria gnatæ.* Earum fructus sunt frequentissimi et sapidissimi."

Professor Robert Hartmann ('Die Nigritier,' pp. 116, 117, 1876) gives the most recent account with which I am acquainted of the date-palm as cultivated in Africa. His remarks as to the existence in Africa of really wild forms of *Phœnix*, *e.g. Phœnix spinosa s. humilis*, the "Kjom-kom" of Senegal, with small well-flavoured fruits, and the *Phœnix reclinata*, a very variable form, to set off against the *Phœnix sylvestris indica* which has so often, though not correctly, been said to

* In the same African connection in Martius's grand book I find the two following passages, which are in themselves a lecture on the extent to which man has modified the landscape of Southern and Northern Africa, both by acclimatising there plants, some useful merely, some beautiful, some both, from "regions Cæsar never knew," China, namely, and America. The maize might have been added to the importations specified in those quotations. Speaking of the date-palm Martius says (p. 264): "In Promontorium Bonæ Spei introducta, nunc per calidiorum regionum hortos sparsa et *una cum Solano tuberoso, Tritico rep.* colitur." Speaking of the North Coast and the *planities Tadschuræ*, he writes: "Palma illic est splendidissimum decus sylvarum *Citri aurantiorum quæ Opuntiis cinguntur.*" The potato, the orange, and the hedges of opuntias set round them were as little known to "all the world" of the Mediterranean as the gas, the coal, the glaze of *our* pottery, and the tea, coffee, and tobacco, which, though sold by the *épicier* in every English hamlet, and making up, as some persons will say, but a Philistine tale, are yet become absolute necessaries of life even to the most cultured of mankind. [Since writing as above I have met with an Address delivered September 24, 1879, by the traveller Nachtigal before the German Association for the Advancement of Science at Baden-Baden. In this Address, delivered in deprecation of certain schemes for the utilisation of certain parts of the Sahara, Herr Nachtigal insists that whatever other results might accrue from the letting in of the waters of the Mediterranean upon the salt marshes of the district referred to by Martius, as cited in the text above, the ruin of the date-culture, the most valuable treasure of that region, would probably be one also. For "the date-palm," says Herr Nachtigal, "wants fresh water for its roots, solar rays for its crown, and fears rain and atmospheric moisture. It is well known that date-plantations in the neighbourhood of the sea produce only second-rate fruit; and there is some ground for doubting whether the regions exposed to the doubtful benefits of the Mediterranean are really the regions which produce the best dates in the world and thereby have earned the name Beled el-Dscherid, that is, literally, the Land of the Date-palm. Would it not be rash to endanger a cultivation, the produce of which is counted by millions of money, for very uncertain results?"]

be botanically indistinguishable from the cultivated *Phœnix dactylifera*, are specially valuable. He insists, as I had also done, previously to becoming acquainted with his views, upon the priority of date, which the Egyptian monuments, with date-palms figured upon them, can show us compared with the Assyrian or Babylonian similarly adorned. The only argument which I can imagine, I have not seen or read of its being suggested by any one else, to be likely to be set against this one based upon the monuments, is one, partly, indeed, based upon ancient Egyptian records, but partly also upon stories recorded for us, with every indication of their being true, by Herodotus. It might run thus. Brugsch (*cit.* Unger, *l. c.* 1839, p. 106. Geographie der alter Egypten, p. 74) tells us that palm-wine is enumerated in the Egyptian Tribute-lists as having been one of the articles received from Babylonia. Herodotus, i. 193, informs us that wine was made from dates in Babylonia; and in a couple of passages, iii. 20, 22, he relates what has become, since his time, the very commonplace occurrence of a superiorly civilised assailing an inferiorly civilised race by means of strong drink. He tells us how Cambyses sent a cask of palm-wine, presumably brought with him from his own country, as a present to the Æthiopians, previously called "blameless" by Homer. The Egyptians, also, according to Herodotus, ii. 86, employed palm-wine (probably, when we compare this passage with the others already cited, from Babylonia) in the process of embalming. I have set up this argument, but I think I may knock it down, and thereby save some of my friends some trouble, by observing that in England we ought not to think that because a country shows pre-eminent skill in manufacturing raw material, that therefore that raw material must even have been grown, not to say, originally found growing wild, in that country. Fusel oil, for example, a product analogous in its operation to palm-wine, is manufactured in this land out of potatoes; but potatoes are not thereby shown to have been first cultivated either in Great Britain or Ireland.

I gather from Martius that "Celsius in Hierobotanico operam dat ut Palæstina tanquam veram hujus arboris patriam esse ostendat."

I, in my turn, venture to advocate the claims of the Nasamones who dwelt around the south-eastern extremity of the *Syrtis major*, now known as the Gulf of Sidra (long. E. 20°), to be considered as the race which first cultivated the palm; and with them I should couple those of the Garamantes of Fezzan. What I have to say about them is based mainly upon the apparently truthful and certainly singularly life-like account

which Herodotus gives of them in three or four passages, i. 32, and iv. 172, 182, 183, none of which Martius refers to in his enumeration of profane writers in contradistinction to the sacred writers who mention date-palms referred to by Celsius; but partly also upon a single passage of Diodorus Siculus, iii. 4. We find thus that the Nasamones were a numerous and powerful, but certainly a very far from civilised people. They combined polygamy with polyandry, much as the Massagetæ did at the same time. Some of their other practices combine several of the notes of a priscan people, such as the veneration of ancestors, and the regard for justice which has made the words *Trollorum fides* proverbial; and finally those social feelings which are indicated by the words, i. 32, *ἀνδρῶν δυναστέων παῖδας ὑβριστάς*, and which Nillson * has averred to be eminently characteristic of savages. I subjoin the entire passage, iv. 172,† for several reasons, in the original Greek; and I submit that a people who embodied so much of wild life in their social condition, could have learnt little from any of the nations to the east of them, whether Egyptian, Arabian, Assyrian, or Persian. But as regards their dealing with the date-palms, we have this remarkable statement made by Herodotus, iv. 172 and 182: "In the summer they leave their flocks by the sea-side, and go up to the district, Augila, to get in the harvest of the date-palms, which grow there in great abundance, and are of great size, all being fruit-bearing." Now Herodotus, and, as he tells us, i. 193, the Greeks of his

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* 'Early Inhabitants of Scandinavia,' Eng. Trans. ed. Lubboek, p. 167, "Aristocraey is strongly developed amongst all savage nations."

† As regards the size of the Fezzan dates, the dates of the Garamantes referred to by Herodotus, iv. 183, as living ten days' journey from Augila westwards, and as having *φοίνικες καρποφόροι πολλοὶ κατάπερ καὶ ἐν τοῖσι ἑτέροισι*, we have the following information from Dr. Ed. Vogel, *cit.* Seemann, *l. c.* pp. 285, 286: "The largest date of Fezzan (which is also the best) is 21½ Parisian lines and 10 in diameter, the smallest 7½ by 5." Lyon, in his 'Narrative of Travels in North Africa,' 1821, p. 72, tells us, "the dates of Sockan in Fezzan are of a quality far superior to any produced in the north of Africa." Herodotus, iv. 172: *Αὐσχισέων δὲ τούτων τὸ πρὸς ἑσπέρης ἔχονται Νασαμῶνες, ἔθνος ἐὸν πολλόν· οἳ τὸ θέρος καταλείποντες ἐπὶ τῇ θαλάσσῃ τὰ πρόβατα, ἀναβαίνουσι ἐς Αὔγιλα χῶρον, ὀπωριεῦντες τοὺς φοίνικας· οἱ δὲ πολλοὶ καὶ ἀμφιλαφέες πεφύκασι, πάντες ἐόντες καρποφόροι· τοὺς δὲ ἀττελέβους ἐπεὰν θηρεύσωσι, αὐήναντες πρὸς τὸν ἥλιον καταλέουσι, καὶ ἔπειτα ἐπὶ γάλα ἐπιπάσσοντες πίνουσι. γυναῖκας δὲ νομίζοντες πολλὰς ἔχειν ἕκαστος ἐπίκοινον αὐτέων ποιεῦνται τὴν μῖξιν· τρόπῳ παραπλησίῳ τῷ καὶ Μασσαγέται, ἐπεὰν σκίπωνα προστήσωνται μίσγονται. πρῶτον δὲ γαμέοντος Νασαμῶνος ἀνδρὸς νόμος ἐστὶ τὴν νύμφην νυκτὶ τῇ πρώτῃ διὰ πάντων διεξελθεῖν τῶν δαιτυμόνων μισγομένην· τῶν δ' ὡς ἕκαστός οἱ μιχθῇ· διδοῖ δῶρον τὸ ἂν ἔχῃ φερόμενος ἐξ οἴκου. Ὀρκίοισι δὲ καὶ μαντικῇ χρέωνται τοιῇδε. Ὀμνύουσι μὲν τοὺς παρὰ σφίσιν ἄνδρας δικαιοτάτους καὶ ἀρίστους λεγομένους γενέσθαι, τούτους, τῶν τύμβων ἁπτόμενοι. Μαντεύονται δὲ ἐπὶ τῶν προγόνων φοιτέοντες τὰ σήματα, καὶ κατευξάμενοι ἐπικατακοιμέωνται. τὸ δ' ἂν ἴδῃ ἐν τῇ ὄψει ἐνύπνιον, τούτῳ χρᾶται. Πίστισι δὲ τοιῇσίδε χρέωνται· ἐκ τῆς χειρὸς διδοῖ πιεῖν, καὶ αὐτὸς ἐκ τῆς τοῦ ἑτέρου πίνει· ἢν δὲ μὴ ἔχωσι ὑγρὸν μηδέν, οἱ δὲ τῆς χαμάθεν σποδοῦ λαβόντες λείχουσι.*

time generally, were acquainted with the bisexual dicœcious character of the palm and the fig; that the Babylonians used artificial means for securing the impregnation of the pistilliferous trees he tells us *in loco;* and we know that those latter were, as they are (see 'Kaempfer,' *l. c.* p. 672) still, to be found in Persia and as they are (see 'Martius,' *l. c.* p. 264) still in Egypt. Some considerable weight, therefore, may fairly be assigned to his statement, iv. 172, to the effect that at Augila (as also probably, see iv. 183, in the country of the Garamantes) there were none but these latter pistilliferous trees. Of course this statement would need supplementation by one which he may very well have supposed his readers would take for granted, to the effect that the Nasamones (and probably the Garamantes) brought the male flowers from a distance, carefully selecting those *liberaliori quodam vigore ac pleniori habitu,* just as Kaempfer, p. 672, tells us the Persian date-farmers did; this being, in fact, the whole pretty nearly of what is required in the way of cultivating the date-palm. The palms resorted to, at least by the Nasamones, were large; they could not, therefore, have been wild date-palms; and being thus proved to be more or less under the care of man, they are, secondly, proved to have been even more under that care and more dependent upon it than cultivated palms elsewhere, inasmuch as the pollen necessary for fertilising their flowers had to be brought to them from a distance, the bridging over of which could only be effected by man's intervention at fixed intervals. My argument, in other words, lies in the fact that a tribe, which, being of very priscan habits and customs, cannot be supposed to have borrowed much from its more civilised neighbours, was, nevertheless, credited in the time of Herodotus with possessing groves of cultivated and exclusively female date-palms, which bore large and, we may, perhaps, infer, excellent dates, as they still continue to do.

We have furnished to us in modern times a verifiable history very closely parallel with that which I here suggest; the *Elæis guineensis* is undoubtedly, as a cultivated plant, an acquisition of negro minds; and as Hartmann says, *l. c.* p. 118, this acquisition has been made for us by a race which still carries on the practice of human sacrifices; and that in sight of European factories and European steamboats, much as the Nasamones, whom I suppose to have discovered the cultivation of another palm, carried on their polyandry almost within sight of the Egyptian pyramids. "The thing that hath been is the thing that shall be."

The picture before you from Kaempfer's 'Amœnitates Exoticæ,'

p. 711, Tab. iii., Fasc. iv. 1711, coupled with his comment * upon the scene of enjoyment which it represents, and in which the palm-trees play so essential a part, may remind us of Linnæus's often-quoted saying, "Man *dwells naturally* within the tropics, and lives on the fruit of the palm-tree; he *exists* in other parts of the world, and there makes shift to feed on corn and flesh." But it may suggest a little more than this. It may cause us to think seriously on the question what will be, not the effect on external nature which man's action will produce, but what will be the effect which external nature will produce upon man, if by some recrudescence of a glacial period, either in a geological sense, or in the economic sense, which an exhaustion of our supply of Nearctic as well as Palæarctic coal would, in the absence of any substitute, bring about, we should be driven southwards, and become tropico- instead of cosmopolitan. What will be the effect of the easy terms upon which life can be maintained in the tropics upon the species which has hitherto never developed a lasting civilisation except under the stimulation "curis acuens mortalia corda" of northern latitudes or mountain elevation?† How will it fare with intellectual culture when and where, not to speak any further of our date-palm, the coconut-palm, the banana, the breadfruit, will make exertion so all but superfluous for the *dura a stirpe genera* who now govern the world? If we are to guide ourselves as we peer into the twilight of the future by what we can see going on in the broad Mediterranean noonday of the present, the example of the idle Corsican is not altogether encouraging. A Corsican family, we are told by their French fellow-citizens,‡ with a couple of dozen of chestnut-trees, and with a herd of goats which "find themselves," to the great disgust of all botanists, have no aspirations left to satisfy beyond that of being able to buy a gun, to the great disgust of all sportsmen. In a matter of prophesying, Sir, the argument from authority and authorities has its legitimate place, and upon the present occasion it happens to have a very legitimate time. I have in a work on 'Hereditary Genius,' published in the year 1869, found it stated that "No Englishman of the nineteenth century is purely

* "Hi sunt palmicolarum in messe, ut sic loquar dactylifera lusus magis quam labores, neutiquam eum nostratium agricolarum infinitis occupationibus comparandi. Heu ilias hic laborum! dum agros effringimus subaramus et resulcamus; dum occamus et liramus, runcamus et refarrimus. . . . Secus sentias de ambrosiis dapibus Persarum et Arabum; hæ gratis omnino et solo almæ naturæ munere conferuntur."

† Wallace, 'Natural Selection,' p. 318; and Bonstetten, 'L'homme du Midi et l'homme du Nord,' 1826, *passim*.

‡ Helm, *l. c.* p. 346.

nomadic:" and that even the most so among them have also inherited many civilised cravings which are necessarily starved, and thus entail personal discomfort and create the required stimulus for their gratification, when they are tempted to let themselves lapse into savage Corsican sloth. In the thousands of years which may yet intervene between us and the necessity for a southward exodus, these cravings and uneasinesses will have become more inseparably a part of our nature than even the most optimistically-minded member of the London School Board can as yet assert they have become. I have not far to look for another authority who will assure us that the desire and appetite for intellectual enjoyment may become as really a "constitutional demand" as those lower stimuli which in "old, unhappy, far-off times" enabled man to subdue other gregarious animals to his own uses, and, so aided, to overrun victoriously the whole globe. Your Secretary, Mr. Bates, after eleven years of absence from England, to which the world owes his charming work the 'Naturalist on the River Amazon,' and after seeing many tribes living in the happy position in which a moderate amount of light work will produce for the simple, peaceful, and friendly people all the necessaries of their simple life (*l. c.*, vol. ii. p. 137 of the Mundurucus), found yet (p. 416) "after three years of renewed experience of England, how incomparably superior is civilised life, where feelings, tastes, and intellect, find abundant nourishment, to the spiritual sterility of half-savage existence, even if it were passed in the garden of Eden. What has struck me," says Mr. Bates, "powerfully is the immeasurably greater diversity and interest of human character and social conditions in a single civilised nation, than in equatorial South America, where three distinct races of man live together. The superiority of the bleak north to tropical regions, however, is only in their social aspect, for I hold to the opinion that although humanity can reach an advanced state of culture only by battling with the inclemencies of nature in high latitudes, it is under the equator alone that the perfect race of the future will attain to complete fruition of man's beautiful heritage, the earth." *

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* V. Baer, who after making himself in his earlier years a prince among biologists, became in his later years a not inconsiderable geographer, expressed himself in Russian so long ago as 1848 in one of the geographical manuals of the Geographical Society of Russia to much the same effect as the two writers above quoted. His words were translated into German no earlier than 1873, and stand as follows in his 'Studien aus dem Gebiete der Naturwissenschafte,' Theil ii., Hälfte i. p. 45–46:

"Mit recht propheziet daher aus dieser Productions-Kraft der Tropenwelt ein geistreicher Botaniker, Herr Meier in Königsberg, dass der Mensch, in der

It is something like an anticlimax to suggest that even when man is in the tropics and surrounded there with all the luscious temptations which the cultivation of those latitudes will give him on such easy terms, he will still be beset with certain urgent needs in the way of supplying his bodily wants as well as his cravings for intellectual excitement and employments. For it is a mistake to think that the craving for flesh and even for fatty foods becomes at all obsolete in tropical countries, or that man is at all less of a flesh-feeder in the regions which are now at least the selected localities of the most typical flesh-feeders, from Carnivora in his own class—through the vertebrate

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eivilisirten Welt rasch sich mehrend, in die heisse Zone zurückwandern werde. Jamaica allein, so gross ungefähr als das Königreich Sachsen, werde vielleicht 25, ganz gewiss aber 12½ Mal so viel Menschen ernähren können als Sachsen. Und wie viele, setzen wir hinzu, die Waldfläche Brasiliens! Verkehrt genug nennt man diesen Boden einen jungfräulichen. Er trug nur für den Menschen bisher wenig Frucht. Dagegen hat der Haushalt der Natur Jahrtausende hindurch in ihm organischen Stoff aufgespeichert für die Menschen, die noch kommen sollen, sowie in andern Gegenden früher, als die Erdrinde sich bildete, in ihr Steinkohlen vergraben wurden als ungeheure Magazine von Brennstoff für eine Zeit, in welcher das vermehrte Menschengeschlecht den Waldwuchs sehr beschränkt haben wird. Aber der Mensch, der aus Europa zurückwandert in die Heimath, aus der er ursprünglich ausgewandert ist, bringt einen Gewinn mit, den er unter den Tropen nirgends erlangt hat, *die Liebe zur Arbeit, die Schätze der Wissenschaft, die Künste der Industrie und die Einsicht in die Bedürfnisse eines geordneten Staatslebens.* Damit könnte er freilich die arbeitscheuen Naturzustände der früher dort ansässigen Völker erdrücken. Aber man darf hoffen, dass unter dessen auch die humane Gesinnung immer mehr sich fest gesetzt haben wird, dass der weiter vorgeschrittene Mensch erkennt, dass er kein Recht hat, den unentwickelten jüngern Bruder zu unterdrücken, sondern die Verpflichtung, ihn schonend weiter zu bilden; dass die Erde ein grosses Waisenhaus ist in welchem die sogenannten Wilden die zahlreichen Waisen sind. Man darf erwarten, dass unter den Tropen, wo weniger Zeit für die Production der Nahrungsmittel erfordert wird, wo die Natur sie an Bäumen reifen lässt, die geistige Bildung viel allgemeinen werden muss als im Norden. In der That hat doch in Mittel-Europa, ich spreche nicht einmal von unserem Norden, nur der kleinste Theil der Bewohner Musse genug, um die geistigen Anlagen, die in ihm schlummern, auszubilden, während die bei weitem grössere Anzahl das ganze Jahr hindurch beschäftigt ist, den Nahrungsstoff zu bereiten. Wie viel mehr Musse hat schon die arbeitende Klasse in Italien! Auch hat sie nicht aufgehört, an Kunst und Wissenschaft sich zu ergötzen, und wird dafür von uns Nordländern mit Unrecht, wie ich glaube, träge genannt. *Europa scheint mir also für die Geschichte der Menschheit, wenn wir sie in grossen Umrissen überblicken, die hohe Schule, wo sie zur Arbeit gezwungen wurde und geistige Beschäftigung lieben lernte.* Möchten unsre Nachkommen der 30sten und 300sten Generation, wenn sie im üppigen Ceylon oder in der ewig gleichmässigen Temperatur der Südsee-Inseln im Schatten der Palmen über die Schicksale der Menschheit nachdenken, anerkennen, *dass wir die Schulzeit im Norden nicht schlecht verwendeten, sondern geistige Gaben auf sie vererbt haben, die unter den Tropen nicht gedeihen konnten, denn noch jezt lebt der Naturmensch dort in sorgenloser Kindheit.* Möchten sie, wenn sie wissenschaftliche Reisen in den Norden unternehmen um den Schnee mit eigenen Augen zu erblicken, mit dankbarer Achtung auf die Ruinen unserer Schul- und Arbeitshäusen sehen."

Mr. Herbert Spencer speaks to the same effect in his 'Principles of Biology,' vol. ii., pp. 502–3.

snakes down to Arachnida in the Invertebrata—than he is in the picturesque wilds where the flesh-furnishing Cheviot sheep are so abundantly forthcoming as to enter even into the landscape. It were a still greater and more serious mistake if any one were to compare, for succulence or sapidity, the flesh-food as yet procurable in the tropics with that which we have furnished us in every well-ordered house, and even hostel, in the United Kingdom of the chilly and rainy isles.

The subject is not altogether romantic, as I have already acknowledged; there is the more reason therefore for putting its practical side prominently forward, and thereby, as we may hope, doing something, however humble, for the bettering of man's estate. That it is not altogether visionary to hope for some improvement in this direction, or to strive to make acquisitions in the way of domestication under a tropical of the same kind as those which our forefathers made under a Central Asiatic sun, the following utterance of the late Dr. J. E. Gray, of the British Museum, an authority untainted with enthusiasm, may be taken as showing. Speaking at the 1864 (Bath) Meeting of the British Association (see Report of Address, p. 83, in Transactions of Sections), of our at present available domestic animals, Dr. Gray said: "An attentive study of the list, and of the peculiarities of the animals composing it, induces me to believe that, in attempting to introduce new domestic animals into some of our colonies, it would be desirable not to confine ourselves to the European breeds, but to ascertain whether some of the domestic races of Asia or Africa might not be better adapted to the climate and other conditions of the colony, although for reasons, to which I have before adverted, it would neither be worth the trouble, nor consistent with good policy, to attempt their introduction here.

"There is evidently ample room for such experiments, which might be advantageously made, for instance, in the colonies of the coast of Africa, where our horse, ass, oxen, sheep, and goats, and even dogs, have greatly degenerated, where the horse and the ass live only for a brief period, where the flesh of the ox and sheep is described as bad and rare, and the flesh of the goat, which is more common, is said to be tasteless and stringy. The pig alone, of all our domestic animals, seems to bear the change with equanimity: and the produce of the 'milch pig' is often sold to passengers of the mail packets, and the ships on the stations, as the milk of the cow, or even the goat, is rarely to be obtained. Unfortunately both the white and the black inhabitants are merely sojourners in the land, and do not

seem to possess sufficient energy or inclination to make the experiment themselves."

There is a more serious aspect or rather prospect of our future relation to the animal world. In this realm of activity, as in some others, we have of late been very rapidly extending our responsibilities. A man needs not to have spent years in the Malay Archipelago as Mr. Wallace has done, nor in the very different surroundings of Siberia as Middendorff has done; nor, Sir, in those of South Africa, to be convinced that the numbers of domesticated animals, I do not say of species of domesticated animals, will assuredly, and at no such very distant period, gain a relative magnitude of which our forefathers, who so patiently won them for us from savagery, could have had no conception. And that earlier than the attainment of this relative preponderance, the domestic animals on this world's surface will be nearly the only large land animals left upon it, and that the wild ones will be but pigmy vermin, "*winzige Ungeziefer*," in Middendorff's words, or, at least, less noble animals, is equally evident. For example, we can see as regards the lion, the king of beasts, that the breech-loading rifle is now rapidly completing what the smooth-bore, with flint and steel, began; for whereas he loses his life by his boldness in coming out into the open, we have in one part of the old world the tiger, and in another the hyæna, substituted for him, a change in neither case much or at all for the better.

I have no reason for doubting that in these days we all consciously strive to act up to what has been spoken of, though not wholly correctly, as "the new commandment of the nineteenth century," "Thou shalt not be cruel;" and I sincerely trust that as regards all animals, domestic and wild, whether in the fields or in the streets and shambles, whether in the woods or within walls, this commandment may, like some others, attain greater extension in practice, as its many-sided applicability becomes more and more manifest. But I think that, even without our intending it, the extension of domestication has increased the sum total of lower animal happiness. A South African traveller, Sir, whose authority you will not repudiate, and we shall not even question, has told us (Galton, 'Domestication of Animals,' Trans. Ethno. Soc. iii. N.S. 1865, p. 122), from his own observation of the still very really wild life of those regions, that it is not after all such unmixed happiness as persons might think, who have never crouched by night by the side of pools in that thirsty land, and watched how nightly drinking, even of water, may lead to much misery. "The life of all beasts," says that

writer, "in their wild state, is an exceedingly anxious one. From my own recollection, I believe that every antelope in South Africa has to run for its life every one or two days upon an average, and that he starts or gallops under the influence of a false alarm many times in the day." Surely whatever the biped, who can foresee and ponderate, may think of the lot, and the future of the domestic Ruminants, their lot, to themselves, as they are not troubled with anticipations, totals up an aggregate of comfort and even of enjoyment far exceeding that which the majority of wild graminivorous creatures of similar bulk ever obtain. A flock of well-fed Cheviots, on a snowy moor, in all their hornlessness and helplessness as against violence, shows the traveller that he is in a country whence wolves have entirely disappeared; would their lot be happier if they were exposed not merely to the winds and sleets of Northumbria, but also to the attacks of wolves to which even in France and Germany they would be liable?

We need not, however, travel in South Africa, as you have done, to prove the point that dog-fights and bull-fights, cockpits and shambles notwithstanding, domestication has, on the whole, increased the sum of the happiness of the lower animals. Let us by an easy effort of imagination figure to ourselves what would become of the flocks and herds of sheep and oxen, "even very much cattle," which are now living with as large a share of enjoyments as, and a very much larger share of leisure at least than many of their masters, if those masters were one and all to be swept away by some epidemic. Suppose, as Dr. Roberts in his memoir on 'Spontaneous Generation' (p. 39) has suggested, that the ferment which produces some one or other of our worse forms of infectious disease should "sport," as it is playfully styled, or vary, as a peach may sport or vary into a nectarine; and then suppose that the increased malignity and infectiousness with which it might thus become endowed, should as entirely destroy our own species within these Islands, as of late years disease has been known to entirely depopulate certain Polynesian islets, or as some analogously-developed disease may be supposed to have exterminated the horse in South America within recent geological periods. There can be very little doubt in the mind of anybody who has much experience of the power of combination for mischief which dogs can, independently of men, develope, even in a civilised and thickly populated country, that in a few days after our disappearance they would be masters of the country. The mere desire for blood which is so eminently characteristic of the musteline carnivores would very shortly and certainly show itself again in our old servants

in their Saturnalia; and in a very short time the entire race of sheep, except in a few mountain districts, would have been as wastefully slaughtered for their blood and fat as flocks and herds have been and still are slaughtered by us in Australia or South America. Oxen would hold out a little longer than sheep, and pigs, I incline to think, longer than either. But that a great diminution of the sum total of brute enjoyment, and, if such a thing there be, of brute happiness also, would take place after we had disappeared, I think needs no demonstration, especially to anybody who, without any experience of any canine mutiny, has ever studied the phenomena of a dog-show or listened at night to the opera which its denizens perform. The various races which, without exactly being domesticated, stand yet on the borderland separating wild from domesticated life, would also very shortly and very sharply have brought home to them the fact of their being more dependent on man than perhaps either they or we have entirely recognised. Rabbits and hares, pheasants and partridges, if they had reason, would reasonably regret the times when they viewed, with something perhaps of disgust, the slouching form of the gamekeeper with his double-barrelled shot-gun perambulating the ridings in the woods and skirting their sunny boundaries. Cats and weasels would with little less delay than the dogs make the life of quadrupeds just specified as miserable as that of the sheep and ox had already been made; and would, after the lapse of a year or two, with the aid of hawks and corvidæ of several kinds, greatly thin their numbers. The river embankments on the lower Thames, lastly, which excited the admiration of Sir Christopher Wren, and were referred by him to the time of the Romans, and also those on many other rivers, having no one to repair any of the breaches which floods would make in them, would before very long allow a very large acreage of land to become swamp, marsh, and lagune; not only thus, on the one hand, depriving many species of animals of their means of subsistence, but also on the other introducing predatory birds, such as gulls, and accelerating the disappearance of many others which really hold their own in such neighbourhoods even now only by man's protection and thanks to his presence.

The purview of this prophecy extends no further than the precincts of the British Islands; in continental countries organic nature would more completely resort to the condition it was in before it began to be modified by man's interference; the *Regnum Hominis* would not be succeeded by the *Regnum Canum familiarium*, but by that of *Canum luporum;* and generally the larger *feræ naturæ*, both those which eat others and those

which are eaten by others, would resume an importance even in the landscape which their extirpation within our four seas has rendered an impossibility for all future time short of the time when the Channel will once again become dry land.

In concluding a Lecture the title of which might serve for the often-to-be-repeated title of many successive and closely printed volumes, let me take as a text the following words from Victor Hehn's book, 'Kulturpflanzen und Hausthiere,' 3rd edition, 1877; Berlin; p. 435), to which I owe more even than I have expressed: "Was die Moderne Welt von der alten unterscheidet ist Naturwissenschaft, Technik und Naturalökomie;" what makes the modern world to differ from the old is natural science, command of apparatus, and political economy. As regards this last differential peculiarity, I have to remark that Herr Victor Hehn's last edition bears the date of 1877, and that, consequently, he cannot have had colonial tariffs either of Melbourne or of Canada before his eyes; nor, though living in Berlin, could he have heard the words uttered there only ten days ago, though they were in an authoritative voice (see 'Times,' May 2nd); nor, finally, could he have been present at a meeting attended in Paris by the representatives of no less than fifty-eight Chambers of Commerce on the very day before, the first, that is, not of April, but of May in this very year of grace 1879. Otherwise I cannot but think that Herr Hehn would not have said the political economy of the present, either as put out in words, or as carried out in practice, was so very different from that of ancient times. To any one at all thick of sight or hard of hearing the proportions of any such difference are wholly inappreciable. I turned to what was one of the favourite studies of my youth, my Aristophanes, and I find Dicæopolis, to adapting whose name Prince Bismarck would, I apprehend, as little object as it would seem he does to his adopting his principles, sighing (in the Acharnians, l. 33–36) for the time when he would get back to his farm * the articles consumed in which at least were "reserved for native industry."

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* Aristoph. Acharn. 33–36.

τὸν δ' ἐμὸν δῆμον ποθῶν
ὃς οὐδεπώποτ' εἶπεν ἄνθρακας πρίω,
ἀλλ' αὐτος ἔφερε πάντα χὠ πρίων ἀπῆν.

Cato and Varro appear, according to the passages given in Hehn, p. 425, to have been similarly in the dark, the first of these averring, 2, 5, in words very nearly reproducing that of Dicæopolis, "Patrem familias vendacem non emacem esse oportet," whilst the latter, 1, 22, 1, in words which the Chambers of Commerce aforesaid re-echoed in their modified Roman tongue, "Quæ nasci in fundo ac fieri a domesticis poterunt, eorum ne quid emātur."

The amount of difference between those views and those of the statesman just mentioned, or those of M. Pouyer-Quertier, or of another countryman of MM. Quesnay, Turgot, and Chevalier who is reported in the same 'Times' of Friday, May 2nd, no time having been lost in giving these valuable views to the world, to have averred that an increase in the imports denoted the impoverishment of a country; I must, as did Captain Lemuel Gulliver under somewhat similar circumstances in Laputa, profess myself to be "not skilful enough to comprehend." What is shown seems to me to be that in modern not less than in ancient times men will run their heads against the multiplication table, and that for the passing moment, at least, it is not always the heads which come off second best in the encounter.

Of the second difference between the old world and the new which our command of methods and means, our recognition of the futility of attempting enterprises with a *manus nuda* and an *intellectus sibi permissus*, has created, the gas, glass, and coal around us in this room speak, and I need not.

As regards the third great point of contrast upon which Herr Hehn insists, that of natural science, we are all probably at one with him. Our agreement may be illustrated by contrasting the different factors which two poets, each an artist capable of taking a wide view with due perspective and proportion of the sum of man's activities, have in ancient and modern times respectively enumerated as making up that sum. When Juvenal specifies what he means by "Quidquid agunt homines," the comprehensive title of his satires, he enumerates nothing because, I suppose, he considered all else as beneath the dignity of a poet, but

> "Votum, timor, ira, voluptas,
> Gaudia, discursus"—

large enough matters, but imponderables all of them. Contrast these items,—I purposely speak in Philistine phraseology—with those which our present Poet-Laureate enumerates in epexegesis of the "march of mind;" there we have the line:

> "In the steamship, in the railway, in the thoughts that shake mankind"

—ponderables and imponderables severally holding their due mutual proportion. And from this line I can pass in this place by a natural and locally suggested transition to what I believe to be as large a difference between the ancient and modern world as either of the two last touched upon. The whole of the old world, of the *orbis veteribus notus*, of πᾶσα ἡ οἰκουμένη,

was but a small fragment as measured by the geographer when compared with the world dealt with our emigration agents and Custom-house officers. The discovery of America has been said to have exercised much the sort of influence upon the old world, socially and politically, that the approximation to our globe of some new planet would exercise astronomically; and since those "spacious times of great Elizabeth" China, Japan, Australia, and Polynesia have each entered into the circle of influences acting upon and acted on by the world as known to the classical writers. In speaking of any district beyond those in relation with the valleys of the Euphrates, the Danube, the Rhine, the Rhone, and the shores of the Mediterranean and Black Sea, the ancients would but say in really pathetic antithesis:

"Longa procul longis via dividit invia terris."

The Brindisi mail brings every manager of a museum, as well as every secretary for the colonies, into weekly relation with "regions Cæsar never knew," by agencies of which he never dreamt and of which in our own times the greatest perhaps of his successors, fortunately for us, as he is reported to have remarked in Plymouth Sound, never learnt to avail himself. And it is in reference to the all-pervading intercommunication which the application of steam to navigation has rendered possible that I wish to utter two concluding sentences, not respecting the vast contrast which it has set up between the present and all preceding centuries, but respecting the contrast which it will shortly have created between the present and all future times. Before this application had established highways on the ocean and invented machinery which

"Spurning sails and scorning oars,
Keeps faith with time on distant shores,"

it was possible on many an oceanic island to recover links which had fallen out of the chain of evidence as to the origin of species which the older and larger continents of dry land had furnished; it was possible also to elucidate the origin, humble and lowly enough, of our own civilisation by what we could see, and not less by what we might fail to discover, in the inchoate civilisations, in similar localities, of semi-savage men. The lines of intercommunication between the most distant parts of our globe, which the navigator with, in his own language, "a steam-engine under his foot," is daily weaving into a more and more nearly all-encompassing web, will very

shortly have introduced so much of the most recent results of our modern civilisation into what were but lately the most secluded of localities as to rob them of that value and interest for the pursuers of the knowledge specified, which they up to a few years ago so eminently possessed.

These few years—for they will be but few—to come, have a great responsibility put upon them in the way of preserving those perishable and destructible links in the history of the past, which may be made incandescent and luminous for the advancement of knowledge, and to some not inconsiderable extent for the benefiting of man's estate.

In this work the Society, which has honoured me by inviting me to address them this evening, has borne a distinguished part in the past, and I cannot doubt, but, on the contrary, have many reasons for believing, that it will bear an increasingly important one in the future.

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